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SUPPLEMENTARY REPORT
MATERIALS HANDLING SYSTEM

BOSTON CITY HOSPITAL

HUGH STUBBINS / REX ALLEN
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MASTER PLAN BOSTON CITY HOSPITAL

SUPPLEMENTARY REPORT
MATERIALS HANDLING SYSTEM

Prepared by:

SOUDER, CLARK & ASSOCIATES
HUGH STUBBINS/REX ALLEN PARTNERSHIP

October, 1969

Hugh Stubbins / Rex Allen Partnership

October 15, 1969

Mr. Robert T. Kenney,
Director
Public Facilities Department of
City of Boston
1 City Hall Square
Boston, Massachusetts 02201

Dear Mr. Kenney:

We are pleased to submit the supplementary report for materials handling systems. This report is the product of the concerted effort of the Partnership architects and our materials handling systems consultant. The resulting system is capable of future growth and change.

We hope this report will assist the City of Boston, the Public Facilities Department, and the Department of Health and Hospitals in achieving the goals of a new Boston City Hospital.

Very truly yours,

HUGH STUBBINS/REX ALLEN PARTNERSHIP

Hugh Stubbins, FAIA   Rex Whitaker Allen, FAIA

MAZ/mh

Reply to:
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SOUDER, CLARK AND ASSOCIATES
18345 VENTURA BOULEVARD • TARZANA CALIFORNIA 91356 • (213) 345 6155

15 October, 1969

The Hugh Stubbins/Rex Allen Partnership
259 Geary Street
San Francisco, California

Gentlemen:

We enclose a report summarizing our study of the development of an automated materials handling system for the proposed new Boston City Hospital as visualized in your Master Plan. Our load analyses and comparisons of machine use with manpower use convince us that such a system can pay for itself over a relatively short span of years. It is probable that the economic advantage will become even greater over time than is now evident since labor costs are likely to increase.

The architectural schema described in your Master Plan offers the opportunity, in its systems floor concept, to install an automated distribution system that offers almost no barrier to internal rearrangement of functional space; thus the continuing adaptability of the buildings to changing use, which you have striven for, may be enhanced.

We hope that the study will prove useful to you in your further design development.

Sincerely,

James J. Souder
James J. Souder, A.I.A.

JJS:ls

CONSULTANTS FOR HEALTH CARE ARCHITECTURE AND PLANNING

BOSTON CITY HOSPITAL MASTER PLAN - MATERIALS HANDLING REPORT

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1.0 INTRODUCTION

The Hugh Stubbins/Rex Allen Partnership has developed a master plan for the architectural realization of the phased redevelopment of the Boston City Hospital. An integral part of the concept is an automated materials handling system to support professional and management activities throughout the institution.

Finite estimates of capital cost and operating cost are not included in this study. Capital costs cannot be determined except in very gross ways until specific plans are submitted to estimate; however, the Master Plan includes one and one half million dollars, each, in the construction budgets for Step 4 and Step 5 to fund such a system. Given the non-competitive situation presently existing in the industry this allowance may be low. The system could cost four million dollars or 25% more. What seems more likely though is the developement of competition which would result in costs more in line with those given in the master plan. Even so the potential savings in manpower, estimated in Section 1.3.1 of this report as $300,000 to $400,000 per year would easily cover interest and amortization payments on a much larger initial investment than that now budgeted.

Operating costs are conjectural, too, because only manufacturer's estimates of probable operating cost are currently available. It is true that numerous individual components of candidate mechanical systems have been used in industry for a number of years, but assemblages of these components in hospital settings are still in the construction stage. Also, the physical configuration of the proposed hospital suggests some combinations of movement components that are not found in either of the currently marketed automated delivery systems.

This study requires that a number of assumptions be made regarding frequency of delivery and collections, levels of consumption of the many items of supply used in the hospital and the census of individuals demanding supply or information at given times. The assumptions used are drawn from experiences found in six large community or university hospitals and two relatively small community hospitals* over a ten year period. The assumptions are documented in Section 1.1.2 in order that they may be revised at any time in an orderly way.

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*Cedars-Sinai Medical Center, Los Angeles
Tufts New England Medical Center Hospitals, Boston
Temple University Hospital, Philadelphia
Indiana University Medical Center, Indianapolis
Hospital of the University of Pennsylvania,Philadelphia
Childrens Hospital of Philadelphia
Newton-Wellesley Hospital, Newton Lower Falls, Mass.
Presbyterian Intercommunity Hospital, Whittier, Cal.

1.1 FUNCTIONAL DESCRIPTION

The purposes of a logistics system in a hospital are to assure the presence of needed supplies, equipment and related information at all points of use in anticipation of need. Its important characteristics are reliability and the minimum use of resources in the process of delivery.

Logistics systems for hospitals have several discrete components. Basically they are three: source, transport linkage and use point. These components have not traditionally been organized to assure reliability, conserve skill use or minimize expenditure.

The rationale underlying contemporary systems imposes responsibility on one hospital agency for purchasing, storing, processing, distributing, collecting, reprocessing and disposal of all items used throughout the hospital. The same agency accepts responsibility for distributing and collecting documents too large to be handled by pneumatic tube systems or dumbwaiters.

In contemporary systems the components are seen as a central plant, similar to an industrial plant which operates 24 hours daily as the sole source of all material, a transport system which may be manned or unmanned and a series of use points which vary in scale. A use point, for example, may be a patient room or it may be a subdepot serving an area in which there are both patient rooms and other facilities. The aggregation of supply functions in one agency relieves technical and professional personnel of duties that do not demand their skills or judgements. It clearly fixes the responsibility for reliable response to professional and technical needs and offers the opportunity by its very size to afford the calibre and quantity of personnel necessary to assure reliable response.

The demands to which the agency responds are, typically, the maintenance of supply levels determined by professional and administrative management, the immediate delivery of randomly ordered items, the distribution of mail, documents and personal packages and the collection of items for reprocessing or disposal. It is not difficult to estimate the demands for items by type and

to establish schedules for meeting them, nor is it difficult to provide in the system sufficient flexibility to permit rapid response to unforseen demands.

These systems attempt to reduce skilled use to the least necessary competence and to substitute machines for manpower whenever operating savings are possible without sacrifice of safety, reliability or need for communication. In inpatient care it has been demonstrated that within the patient care areas the tasks of fetching and returning supplies consume fifteen minutes per occupied bed per day in a well organized setting.* In less organized settings they require more time, which is usually provided by nursing staff. The substitution of mechanized delivery from central source to use points for manned attendance has been demonstrated to eliminate the need for large numbers of staff positions, commonly enough to compensate for interest and amortization of the mechanical equipment over relatively short periods of time.** The total logistics system encompasses both types of operation under single control and offers substantial opportunity for operating economies.

* Souder, J. J., Study of Service Times and Travel Times for Logistics Services, Temple University Health Sciences Center, 1968.

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1.1.1. THE COMPONENTS

The three major components of the logistics system may be described as follows:

1. The Central Source. Ideally a very large, horizontal space with good trucking access is arranged to include receiving, unpacking, breakdown storage, an order assembly area designed somewhat like a supermarket and a terminal of a mechanized transport system. The assembly area stocks, ready for delivery, the products of laundry, housekeeping, central sterile supply, paramedical supply and purchasing. It is flanked both by these functional units and by pharmacy, dietary and maintenance departments. It also has a secondary transport terminal for receiving used and reprocessible supplies. This latter terminal includes an unloading and sorting area which directs returned items to trash, laundry, dietary or cleaning and reprocessing. Cleaned items go by conveyor to pharmacy, central supply or the assembly area.

   Orders are filled and leave the distribution center by self directing conveyors. Returning conveyors are unloaded, sent through an automated wash cycle and queued up in a parking area for reuse. Specially designed dietary conveyors are usually returned to the dietary department. If disposable dishes and trays are not used, however, these conveyors must pass a dishwashing point for unloading before going through the wash cycle.

   The contiguity of these functional elements with one another and with the distribution terminal and truck dock facilitates the movement of daily supply needs among them. Relieving technical people in pharmacy, central supply and dietary of order assembly and dispatch responsibility saves skill and at the same time permits the organization of a disciplined, minimally manned, distribution service.

2. The Transport Linkage. The work day in modern medical centers generates a very large volume of travel - about 50 interdepartmental trips for patient related purposes per bed per day. For Boston City Hospital this equates to 65,000 trips per day. About 2.5 trips per bed per day in non-automated hospitals are supply or supply return trips. With automated systems

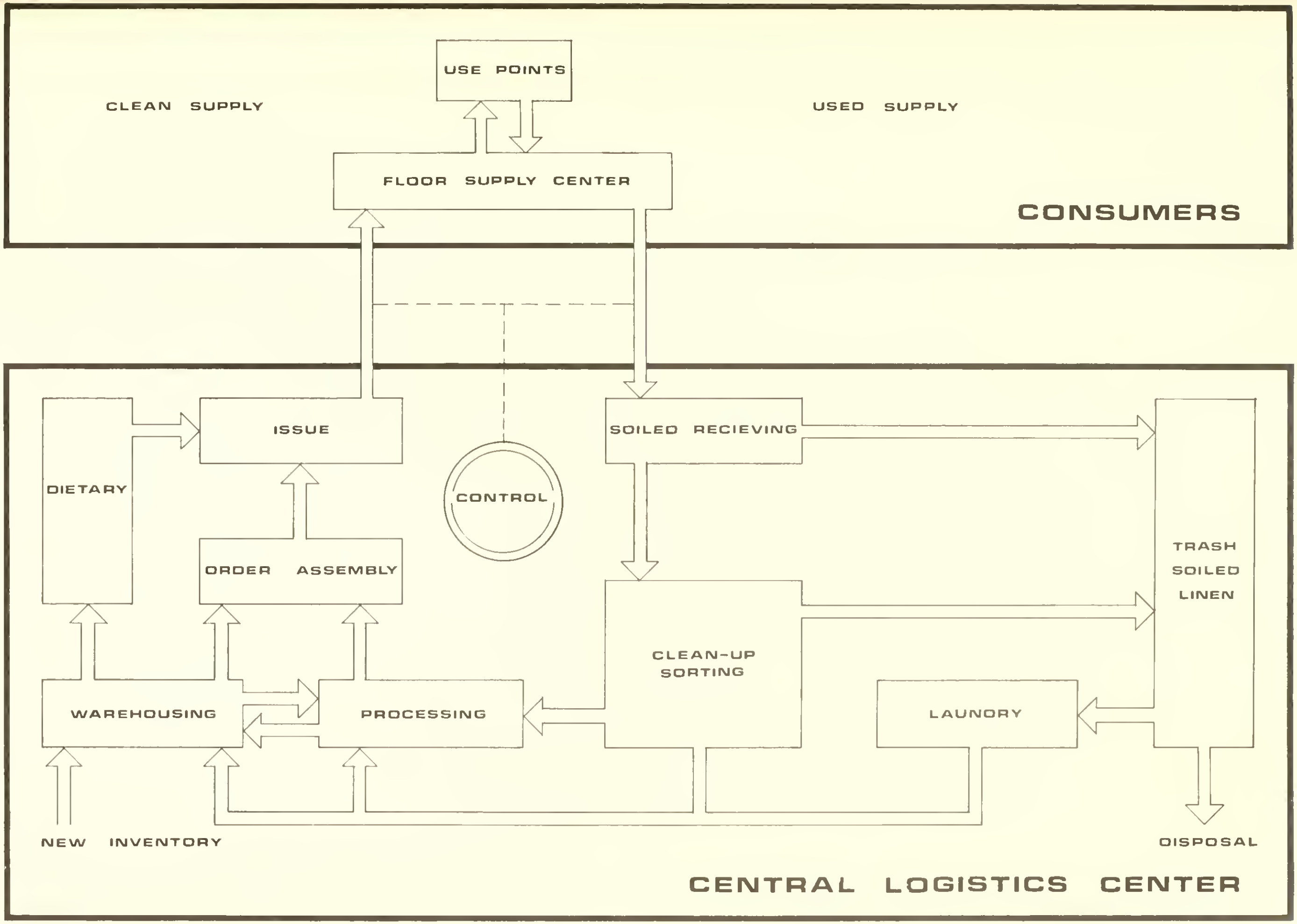
the percentage is reduced, but at Boston City Hospital our estimate is approximately 2.3 supply trips per bed per day for a total of 2,990 trips per day. It is the substitution of machine for man in these trips that provides justificaton for automating. The transport link is usually a horizontal-vertical delivery system in which conveyors of substantial size can be directed to seek a predetermined destination, disengage themselves from the system, await unloading and then be directed to return to a selected point. Levels of sophistication can be varied to suit delivery demands of different kinds or to suit varying planning configurations. In large systems the unmanned pathways are typically monitored by television or electronics to detect breakdown.

Alternative substitutions of machine for man will be discussed later. The point to be made here is that the responsibility for reliable delivery, the scheduling of system operation in ways that minimize the working day and the assurance of having constant delivery capability demand competent management supervision.

3. The Outlying Depot. Thus far it is not economical to automate the delivery of each supply item to its ultimate use point. Accordingly, way stations are usually established along the delivery trackage. These outlying depots are usually divided into two areas: one in which only clean supply is handled and one in which soiled supply is collected for the return trip. Their incidence and their sizes are related, first, to function of the area served and, second, to the manpower demand for local use point delivery and pick up. Commonly operating pavilions are given discrete subdepots directly tied to the transport system. In other cases nursing areas may share the services of a subdepot with other services that are geographically close by.

   The outlying depot should be managed by an individual who is technically responsible to a director of logistics but administratively responsible to the element of management his depot serves. He thus becomes a member of a multidisciplinary team who share common goals.

   The components and their relationships are shown in Diagram 1.



MATERIALS HANDLING SYSTEMS

DIAGRAM 1

1.1.2 OPERATING CONVENTIONS AND LOAD FACTORS FOR CATEGORIES OF SUPPLY

To estimate the capability requirements and service characteristics of a logistics system it is first necessary to establish operating conventions. These conventions represent management's estimates of the frequence, volume and pattern of delivery and collection functions. When these estimates are aggregated for all of the use points and all of the categories of supply, the operating needs of the entire system become evident. Some of these assumptions relate to the proposed physical configuration of the building being designed; some relate to needed periodicity rather than to volume; some relate almost entirely to volume. It is important to document the assumptions in order that estimates of system requirement may be adapted to changes as they develop.

Deliveries are identified as either routine or "stat". In theory, stat deliveries of supply items should be infrequent - each area of the hospital should be stocked with a reserve supply of rarely needed but importan items. It is useful, however, to classify as stat certain kinds of deliveries that occur randomly by nature. Examples of these are medical records for unprescheduled readmissions and walk-in ambulatory visits, tissue specimens and reference documents.

The outline of conventions and load factors that follow is related to categories of supply which are described in Appendix A. The conventions are drawn from measured experience in a number of other hospitals and from Souder, Clark and Associates experience. Delivery requirements for food, linen, operating and delivery room supplies and trash are large volume with understandable bases and documented experience. Deliveries of paperwork, specimens and reprocessibles are related to functions where periodicity is important to work flow and arbitrary rules can be laid down to support it. A number of items such as furniture, large equipment, blood, gas cylinders, by their nature require human attendance in transit and are not included in the conventions. Most other items are delivered in quantities quite small in relation to most automated delivery systems and rarely require mor than a weekly replenishment of complement at outlying depots which, in turn, may update the complements of small, local

use points. In general the chosen conventions are generous in order to permit some flexibility for change and some change in standards - the upgrading of linen utilization, for example, or increased trash loads resulting from accelerated use of disposables or the application of computer technology to information handling.

1. Administrative Supply: Administrative supply consumption consists generally of small quantities of many items and occurs in all functional areas of the hospital. It is delivered once weekly to each use point and these deliveries are combined with deliveries of housekeeping supplies.

2. Dishes: Dishes are collected from all inpatient care and catering points after each meal and returned to central dishwashing unless they are disposable, in which case they are returned on the same schedule as trash to the central disposal point. Nourishment dishes are assumed to be disposable. Cafeteria and coffee shop dishes are assumed to be washed at the use point rather than being transported to a central dishwashing point.

3. Drugs: Routine deliveries are made weekly to the following points:

    Dispensing centers

    Inpatient care units

    Ambulatory clinic centers

    Emergency department

    Service laboratories

    Special laboratories

    Research laboratories

    Surgery

    Delivery suite

    Diagnostic

    Radiology - Therapeutic

    Nuclear medicine

    Blood bank

In addition, capability is provided for two stat deliveries daily to each dispensing center including those in inpatient care areas.

4. Food: Food services are provided to patient rooms, dining rooms, coffee shops, vending areas and special meetings, which may occur anywherein the hospital but usually occur in administrative and conference areas.

For Boston City Hospital the assumptions are:

(1) that patients will be served five times daily, twice by tray with convenience foods, and three times by nourishment cart, (2) that staff meals will be served in the cafeteria in the numbers set forth in the LGAI Report, (3) that each of two vending points is stocked four times daily and (4) that .05 meals per patient day will be catered in administrative areas.

The per meal weights of delivered food are estimated as follows, in pounds:

a. PATIENT MEALS:

Continental breakfast	.6
Brunch	1.5
Snack	.6
Dinner	2.2
Snack	.6

b. STAFF CAFETERIA MEALS, AVERAGE: 1.67 LBS.

Food delivery and cart pick up for 4500 is assumed in accordance with LGAI estimates.

c. COFFEE SHOP MEALS:

The LGAI Report does not estimate the number of meals to be served in coffee shops. Experience elsewhere indicates 1.1 to 2.3 snacks per patient day, or for 1300 beds 1290 to 2700 snacks. In the interest of conservative estimating 2700 snacks at 1.0 lbs. each and dish setups for 1350 have been assumed.

5. Housekeeping Supply: Clean housekeeping supply consists of increments necessary to maintain predetermined stock levels at all use points. These are delivered to each use point once a week and these deliveries are combined with deliveries of administrative supply.

   Used material is returned as trash, soiled linen, or reprocessibles.

6. Linen and Uniforms: Several assumptions regarding the number of people to be served per day have been made.

   a. Inpatient beds will have average occupancy of 90%. The discharge rate per day will average ten per cent of beds.

   b. Surgery, with a projection of 19,820 operations a year in the LGAI Report, is estimated here on the basis of a five day week with no down time which yields an average of 76 cases per day.

   c. Obstetrical Delivery is estimated to handle 3000 deliveries a year which would average eight per day. Because peaks are common, 12 deliveries per day have been estimated.

   d. Radiology: Twenty diagnostic radiology rooms are programmed for which no utilization data are projected. Based on detailed studies of radiological activity elsewhere by type, incidence and durations of procedures by Souder, Clark and Associates and Community Systems Foundation, the case load is estimated at 200 patients per day.

   e. Laboratory: The LGAI Report estimates 7400 automated tests and 1860 manual tests daily. Since personnel should be able to handle 30% more automated tests in the same time span as manual, the assumption of 7860 total tests is made as base for projecting laboratory personnel linen demands.

   f. Rehabilitation: Based on staffing deduced from the LGAI Report and estimates of patients handled per man per hour in counseling and testing (2), occupational therapy (2), brace shop (1), physical therapy (2) and speech therapy (1), it is estimated that 416 patients will be seen daily.

g. Emergency Service: The estimated 200,000 visits per year in the LGAI Report average 550 per day with an assumed peak of 700. In addition, the 24 bed observation unit is considered as an inpatient care unit for all logistics purposes.

h. Outpatient Clinics: The twenty modules, planned to handle 15,000 visits per year but each capable of handling 24,000 visits per year or 80 per day, afford 1600 visits.

i. Doctors' offices are assumed to be evenly distributed in parallel with the outpatient modules.

The delivery of linen and uniforms to using agencies is estimated on the basis of weight or of cubic footage, whichever is the greater demand factor. The weight/volume ratio of the several kinds and mixes of linen has been taken into account in the calculations. The following load factors have been assumed:

a. Except as noted, linen and uniforms will be delivered daily from the central distribution service regardless of laundry operation. Uniforms will be delivered to the site of lockers used by personnel concerned. Staffing figures are taken from the LGAI Report or inferred from it on the basis of work stations provided.

b. Soiled linen weighs ten per cent more than clean linen and occupies twice the volume in transport.*

c. For ambulatory care and emergency care 1.34 pounds or .09 cubic feet per visit per day of clean linen will be delivered daily, including uniforms.

* Sources: Data on dry and soiled linen weight from Fritz Field, Laundry Consultant, New York, utilization data from Indiana University and Temple University Medical Centers, empirical studies of volume weight and shelf volume conducted at Temple University by T. McGoldrick and J.J. Souder, Sr.

d. Central processing will receive 3.5 pounds of linen per patient day from the laundry, process it and issue it. The linen received will average 13.5 pounds per cubic foot. Issued material, including packs will average 11 pounds per cubic foot.

e. Delivery and surgery, including post anaesthetic recovery, will receive 12.5 pounds or 1.6 cubic feet per case per day including allowance for reserve linen, personnel linen. Packs are included in sterile supply delivery.

f. The dietary department will receive .24 pounds of clean linen per patient day including 1 pound of uniform issue per employee directed two thirds to the kitchen, one third to dining points.

g. Housekeeping uniforms for 400 personnel will be delivered daily to locker sites at the rate of one pound or.03 cubic feet per uniform.

h. The human functions laboratory will receive 33 uniforms per day. No allowance is made for patient linen.

i. The inhalation therapy service will receive 26 uniforms per day. No allowance is made for patient linen.

j. Each inpatient care unit will receive 16.24 pounds, or 1.76 cubic feet, of clean linen per patient day to include the patient pack, extra patient linen, reserve replenishment and discharge packs. This average applied uniformly disregards variances among inpatient services.

k. The service laboratories will receive .03 pounds or .004 cubic feet per procedure per day, including uniforms, once a week.

l. The laundry will receive 76 uniforms per day.

m. The central pharmacy will receive 23 uniforms per day. There being no staffing data on unit dose pharmacies, their quotas, which should not exceed two uniforms each, are included in patient linen.

n. The nuclear medicine department will receive 14 uniforms per day. No allowance is made for patient linen.

o. Plant maintenance will receive 71 uniforms per day.

p. Radiology will receive .64 pounds or .04 cubic feet per day plus uniforms for 60 staff members. Radiotherapy will receive the same allowance, but since no work load data are assumed, based on observed experience at Memorial Hospital, New York, and uniforms for 18 staff members are provided.

q. For rehabilitation 3.94 pounds or .27 cubic feet of linen per visit are provided for physical therapy plus 30 uniforms for staff of the department.

r. For stores and distribution 35 uniforms per day are provided.

7. Medical and General Supply: These materials are supplied once weekly in a shared delivery furnishing sterile supply to each inpatient nursing center, outpatient care center, emergency, surgery, delivery, service laboratories, special laboratories, research laboratories, surgical pathology, blood bank, radiology, radiotherapy, physical medicine, pharmacy, nuclear medicine, inhalation therapy.

8. Paperwork: Paperwork will be delivered and picked up at all use points five times each day. The advent in the future of fully automated information handling will reduce this demand, but mail, books, journals, etc., will always have to be circulated. In addition the following deliveries will be made for medical records:

   a. For each outpatient care center there will be an a.m. and p.m. delivery of records for scheduled visits plus an allowance of one stat delivery per each 10 expected visits.

   b. For inpatients there will be an a.m. delivery to the admissions point for scheduled admissions plus an allowance of one stat delivery for each 20 admissions to the patient processing center. This is assumed to be a lateral, manual delivery. It should be noted that if the admitting procedure occurs on the patient floors, this load might have to be directed from the Medical Records Department via conveyor system to floor administrative centers.

9. Paramedical Supply: Demands for paramedical supply are unpredictable. The assumption is that in most cases deliveries will be made on call to replenish local stock. While these deliveries may be consolidated with others, the following stat delivery allowances are included in the estimates:

   a. To inpatient care units: one per day per 30 beds.

   b. To Emergency: eight per day

   c. To physical medicine: one per day

10. Reprocessibles: Two collection trips per day from each point receiving sterile supply are programmed for reprocessibles in the interest of maintaining work flow in central processing.

11. Specimens: In the interest of saving laboratory technicians the time required to travel redundantly between the collection points and the laboratory, six collection trips per day are scheduled from each inpatient and each ambulatory patient care unit. Tissue deliveries to surgical pathology are considered stat and are included in other surgical delivery and collection allowances.

12. Sterile Supply: It is anticipated that all processing, packaging and sterilizing of materials requiring sterility will occur in the central processing center. The products will be stored in the distribution center and issued by logistics personnel. Whether or not disposables are substituted for reprocessibles the delivery loads should remain approximately the same. It will be delivered as follows:

a. Each inpatient nursing unit, each ambulatory care module will receive one delivery daily. In addition, one stat delivery daily is provided for each 30 beds.

b. Surgery and delivery suites will receive a specially stocked cart for each case.

c. Surgery and delivery will also receive:

One reserve instrument and supply delivery per twenty cases.

One fluid delivery per twenty cases.

One gas delivery per twenty cases

One undefined stat delivery per ten cases

d. The Emergency Department will receive four daily routine deliveries including instruments and supplies, fluids, trays and sets, plus sixteen stat deliveries.

e. Surgical pathology will receive one daily delivery.

13. Trash is scheduled for collection twice daily for each 30 beds, five times daily from each dining point, three times daily from the gift shop and once daily for each 3000 net square feet of space in all other areas.

1.1.3 TRANSPORT LINKAGES: ORIGINS AND DESTINATIONS

The estimates of load for the logistics system are based on the peak weekday requirements of individual functions within the institution. Then the locations of these functional units in the proposed master plan are examined to determine locations for outlying depots to serve them and these depots become nodes on the transport linkage.

The selection of nodes is also influenced by an assessment of the demands of its tributary area for local manpower usage in distributing and collecting from individual use points within the area, such as patient rooms. For example, in other studies* it has been estimated that the daily demand for local logistics chores in acute nursing units totals 19 minutes per bed per day if food distribution and escort service are included in the duties of the logistics technician. The figure drops to fifteen minutes per bed per day if these two responsibilites are withdrawn. Thus a 48 bed nursing unit would require 12 to 16 man hours per twenty four hour period. Since most work is done in two shifts it would appear reasonable to establish a node for each 48 beds and in the future to staff only one of them at night to serve the full 96 bed floor.

Each of the designated nodes, which occur along the vertical and horizontal supply pathways shown in the Master Plan, serves one or more functional elements physically close to it. The load calculations are summarized in such a way that service loads, and therefore the need for vertical risers, in the core services, high rise and the outpatient building can be read easily. The grand total indicates the demands on the main trunk connecting the Service Building with the balance of the hospital.

THE NODES

Each node represents an outlying depot which receives clean incoming material for distribution and maintains a small reserve complement of clean material and equipment such as wheelchairs and stretchers. It is also the collecting point for returning soiled materials and trash. Predirected containers of clean material are automatically ejected into it to await the attention of the logistics technician who manages local distribution. A signal is activated if the attention is not forthcoming within prescribed time limits. Containers of soiled material accumulated at the depot are dialed to the appropriate destination by the technician and dispatch themselves without further attention.

* Souder, J. J. Study of Service Times and Travel Times for Logistics Services, Temple University Health Sciences Center, 1968.

The selection of nodes relates closely to function and to the architecture proposed to house this function. The architectural plans for new structures propose one node per 48 bed nursing unit, one node per floor in the Outpatient Building and three nodes on each floor of Core Services areas. These nodes are connected to one another and to the Service Building by a discrete traffic pathway which will be the route available to the transport system.

The nodes nominated are related to demands of the functions they serve. Alternative ways of serving the nodes will be discussed in a later section of this report.

For future reference the proposed nodes have been numbered, the first symbol representing building, the second representing floor level, the third representing location on the floor. The proposed nodes for Step 4 are:

NODE No.	FLOOR	BUILDING	FUNCTION
C.B.2	B	Core Services	Lockers, Housekeeping
C.1.1	1	Core Services	Administration, Radiotherapy
C.1.2	1	Core Services	Emergency
C.2.1	2	Core Services	Management Administration
C.2.2	2	Core Services	Patient Processing
C.3.1	3	Core Services	Inhalation, Therapy, Human Functions Lab.
C.3.2	3	Core Services	Diagnostic Radiology, Nuclear Medicine
C.4.1	4	Core Services	Delivery
C.4.2	4	Core Services	Surgery
C.5.4	5	Core Services	Cafeteria and Lecture
C.6.4	6	Core Services	Outpatient Clinic

NO.	FLOOR	BUILDING	FUNCTION
I.7.4- I.7.20	7-20	Inpatient	14 Nursing Units
O.1.5	1	New Outpatient	Information, Triage, Admitting
O.2.5	2	New Outpatient	Outpatient Clinics Doctors' Offices, Pharmacy, Shop, Cafe
O.3.5	3	New Outpatient	Outpatient Clinics, Doctors' Offices, Dining
O.4.5	4	New Outpatient	Nursing Units, Outpatient Clinics

The added nodes for Step 5 are:

C.1.3	1	Inpatient	Clinical labs.
C.2.3	2	Inpatient	Administration
C.3.3	3	Inpatient	Rehabilitation
C.4.3	4	Inpatient	Optional for use in surgical expansion
C.5.5	5	Inpatient	Cafeteria
C.6.5	6	Inpatient	Outpatient Clinics
I.7.5- I.20.5	7-20	Inpatient	Inpatient Care

The loadings for the nodes are described in Section 1.2 and the choice of transport systems in Section 1.3. There are 27 nodes in use areas nominated for Step 4 and 46 in Step 5.

These nodes are connected by major horizontal pathways to the Service Building.

THE SERVICE BUILDING

The Service Building presents special problems because of the constant interchange of materials among its elements and the fact that site constraints preclude a horizontal arrangement of them.

Ideally the logistics systems' central plant would have a rotary horizontal flow such as that indicated in diagram 1 because each of the system components draws on most others for supply or service. Every component draws on the storage elements and delivers to the disposal elements as well as to inhouse users. The decontamination unit delivers to pharmacy, central processing, the laundry and disposal. The laundry, in turn, delivers to central processing (for pack preparation) and to the distribution center. While dietary need draw only on the receiving dock if it operates a discrete storage unit it must deliver to the distribution point and to the disposal point, and in the best of circumstances would not use its trained employees for distribution chores.

An automated logistics system presupposes that every carrier circulated to a use point is considered exposed, or soiled, on its return trip. It returns to a decontamination area, where it is unloaded if need be, and automatically dispatched to a mechanical washing center. Clean, it is redispatched to queue up for service calls.

One of the management goals of the system is so to organize delivery and collection schedules that the work force in the central plant can get done in one shift all that work which cannot be performed by skeleton crews on the other two shifts, who are on duty primarily to provide 24 hour response to user demands.

A major reason for a common distribution center for all items of supply is the relegation of non-technical, order filling tasks to non-technical personnel. Another reason is the concentration of supervision on few but very busy work centers. Maintaining a crowded distribution schedule within a minimum work day, too, requires substantial supervisory skill if user demands are to be met reliably on schedule.

All outbound loads should emanate from one order filling and dispatch point. All returning loads should reach one decontamination and cart washing point. Industrial conveyors and pneumatic chutes should provide unmonitored delivery to laundry, to waste disposal points and to central processing. The balance of the inter-component movement should be handled by an internal distribution system. The characteristics of this internal system should be determined in a separate study.

The level of activity in the distribution center, or staging area, merits special attention. The load analyses detailed in Section 1.2 emphasize this. The dispatch of 1500 carriers and the receipt of 1800 returning carriers in a sixteen hour period amounts to roughly 3.4 transactions per minute to a major marshalling yard with an operational goal of performing almost all of its work in a two shift day. Even in step 4, where automated delivery is limited to new structures, the total demands on service block functions will be as great as if the entire hospital were provided with automated delivery. It requires careful analysis of tolerances for order filling, dispatching, cleaning, cart washing and garaging. An automated cart washer, for example, will handle one to two carts per minute dependent on manufacture.

1.2 LOAD ANALYSES

The essence of the load analyses is presented on the following pages in Diagram 2, which shows the estimated demands for delivery of individual containers of supplies by type at each functional use point in the Hospital for Step 4 and Step 5 respectively. The estimates are derived from a matching of the already described operating conventions, load factors and node network.

The format of the diagram identifies nodes, the daily cartload demands for each of 14 categories of delivery or pickup and total demand for A, an Amsco system and B, a Cyberail system.

The analyses are presented only for Steps 4 and 5 of Hospital development. Prior to completion of Step 3, which coincides with completion of Step 4, the Service Building is not equipped to support a logistics system.

The analyses also present the differences between the two major available fully automated transport systems in number of unpowered carrier modules required to handle the loads. The systems are Amscar, the product of the American Sterilizer Co., and Cyberail, the product of the Castle Automated Systems Division of the Sybron Corporation. On the diagram the former is indicated as System A, the latter as System B.

The Amscar standard carrying container holds 32 cubic feet or 900 pounds total load including container and measures 26 inches by 48 inches by 48 inches with open top. The Cyberail standard carrying container holds 18 cubic feet or 220 pounds of load excluding container and measures 15 inches by 49 inches completely closed.

The Amscar system at full capacity can handle 40 carriers per hour on its vertical component. The Cyberail system can handle up to 500 depending on the complexity of routing and switching; a capacity of 300 carriers per hour is considered a safe estimate.

The analyses indicate that for Step 4 with 1300 beds in operation there should be a total of 764 supply trips and 851 return trips, or a total 1615 trips per 24 hour period for an Amscar system. The corresponding numbers for a Cyberail system are 913, 1048 and 1961, respectively.

The loads for Step 5, with 1300 beds are 1291 supply trips, 1476 return trips, or a total of 2768 trips for Amscar and 1531, 1808 and 3340 trips for Cyberail.

The differences are attributable in both cases to the differential in carrying capacity for those supply movements where volume is the critical factor. It does not follow, however, that these differences in numbers of trips infer meaningful staffing differences for their loading and unloading. The orders to be filled are the same in either case, regardless of whether they are placed in one carrier or two. A glance at Diagram 2 will show that the Cyberail system requires more carriers than Amscar in the movement of only food, linen and trash. In all other cases the capacity of either carrier exceeds any individual demand.

Neither do these differences suggest any significant differences in initial costs between the two systems.

TRIP LOADS PER DAY FOR TWO ALTERNATIVE MATERIALS HANDLING SYSTEMS

Completion of
STEP 4 DELIVERY SCHEDULE

CORE SERV.AND	F o o d		Admin Sp Hskfg Sp		Ster Sp Med&Gen		Para Md		Drug Sp		Lin-Unif		Med Rec Paperwk		Total	
INPATIENT	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
3 Lckrs-Hskpg	-	-	.2	.2	-	-	-	-	-	-	1.0	1.0	5.0	5.0	6.2	6.2
1 Admin	-	-	.2	.2	-	-	-	-	-	-	-	-	5.0	5.0	5.2	5.2
1 Rad Ther	-	-	.2	.2	1.0	1.0	-	-	2.2	2.2	1.0	1.0	5.0	5.0	9.4	9.4
1 Emerg	5.0	7.0	.2	.2	22.0	22.0	8.0	8.0	2.2	2.2	3.0	4.0	5.0	5.0	45.4	48.4
2 Mgt Admin	3.0	5.0	.2	.2	-	-	-	-	-	-	-	-	5.0	5.0	8.2	10.2
2 Patient Proc	-	-	.2	.2	.2	.2	-	-	-	-	-	-	5.0	5.0	5.4	5.4
3 Inhal Ther	-	-	.2	.2	1.0	1.0	-	-	2.2	2.2	1.0	1.0	5.0	5.0	9.4	9.4
3 Rad Nuc Med	-	-	.2	.2	1.0	1.0	-	-	2.2	2.2	1.0	1.0	5.0	5.0	9.4	9.4
3 Rad Diag	-	-	.2	.2	1.0	1.0	-	-	2.2	2.2	1.0	1.0	5.0	5.0	9.4	9.4
4 Surgery	-	-	1.0	1.0	53.0	53.0	1.0	1.0	2.2	2.2	2.0	4.0	5.0	5.0	64.2	66.2
5 Restaurant	40.0	66.0	2.8	2.8	-	-	-	-	-	-	1.0	1.0	5.0	5.0	48.8	74.8
6 O.P.	-	-	.2	.2	1.0	1.0	-	-	2.2	2.2	2.0	3.0	47.0	47.0	52.4	53.4
7 + Inpatient	140.0	196.0	2.8	2.8	42.0	42.0	23.0	23.0	30.8	30.8	44.0	84.0	5.0	5.0	287.6	383.6
															561.0	691.0
OUTPATIENT																
1 Admissions	-	-	.2	.2	-	-	-	-	-	-	-	-	38.0	38.0	38.2	38.2
1 Amb Rec	-	-	.2	.2	-	-	1.0	1.0	-	-	-	-	5.0	5.0	6.2	6.2
1 Lobby-Info	-	-	.2	.2	-	-	-	-	-	-	-	-	5.0	5.0	5.2	5.2
2 O.P.	-	-	.2	.2	1.0	1.0	-	-	2.2	2.2	1.0	2.0	31.0	31.0	35.4	36.4
2 Pharm-Shp	-	-	.2	.2	1.0	1.0	-	-	2.2	2.2	-	-	5.0	5.0	8.4	8.4
3 O.P.	-	-	.2	.2	1.0	1.0	-	-	2.2	2.2	1.0	2.0	31.0	31.0	35.4	36.4
3 Lect x 2	-	-	.2	.2	-	-	-	-	-	-	-	-	5.0	5.0	5.2	5.2
4 N.U.	10.0	14.0	2.2	2.2	3.0	3.0	2.0	2.0	2.2	2.2	3.0	7.0	5.0	5.0	27.4	35.4
3 Vending 1	4.0	4.0	.2	.2	-	-	-	-	-	-	-	-	-	-	9.2	9.2
2 Vending 2	4.0	4.0	.2	.2	-	-	-	-	-	-	-	-	-	-	9.2	9.2
															203.2	222.2
															764.2	913.2

Total trips	System A	System B
In and Out	1615.2	1961.2

Diagram 2 (Page 1 of 4)

STEP 4 PICK UP SCHEDULE

CORE SERV.AND INPATIENT	Linen A	Linen B	Trash A	Trash B	Dishes A	Dishes B	Spec A	Spec B	Reproc A	Reproc B	Paperwk A	Paperwk B	Total A	Total B
3 Lckrs-Hskpg	1.0	2.0	8.0	8.0	-	-	-	-	-	-	5.0	5.0	14.0	15.0
1 Admin	-	-	2.0	2.0	-	-	-	-	-	-	5.0	5.0	7.0	7.0
1 Rad Ther	1.0	1.0	3.0	3.0	-	-	-	-	1.0	1.0	5.0	5.0	10.0	10.0
1 Emerg	5.0	7.0	12.0	12.0	5.0	7.0	6.0	6.0	7.0	7.0	5.0	5.0	40.0	44.0
2 Mgt Admin	-	-	5.0	5.0	3.0	5.0	-	-	-	-	5.0	5.0	13.0	15.0
2 Patient Proc	-	-	14.0	14.0	-	-	-	-	-	-	5.0	5.0	19.0	19.0
3 Inhal Ther	1.0	1.0	3.0	3.0	-	-	-	-	1.0	1.0	5.0	5.0	10.0	10.0
3 Rad Nuc Med	1.0	1.0	3.0	3.0	-	-	-	-	1.0	1.0	5.0	5.0	10.0	10.0
3 Rad Diag	2.0	2.0	3.0	3.0	-	-	-	-	1.0	1.0	5.0	5.0	11.0	11.0
4 Surgery	4.0	7.0	5.0	5.0	-	-	6.0	6.0	40.0	40.0	5.0	5.0	60.0	63.0
5 Restaurant	1.0	1.0	5.0	5.0	40.0	66.0	-	-	-	-	5.0	5.0	51.0	77.0
6 O.P.	3.0	5.0	11.0	11.0	-	-	6.0	6.0	1.0	1.0	7.0	7.0	28.0	30.0
7 + Inpatient	88.0	168.0	56.0	56.0	140.0	196.0	84.0	84.0	28.0	28.0	5.0	5.0	401.0	537.0
													674.0	848.0
OUTPATIENT														
1 Admissions	-	-	-	-	-	-	-	-	-	-	5.0	5.0	5.0	5.0
1 Amb Rec	-	-	-	-	-	-	-	-	-	-	5.0	5.0	5.0	5.0
1 Lobby-Info	-	-	1.0	1.0	-	-	-	-	-	-	5.0	5.0	6.0	6.0
2 O.P.	2.0	3.0	11.0	11.0	-	-	6.0	6.0	1.0	1.0	7.0	7.0	27.0	28.0
2 Pharm-Shp	-	-	3.0	3.0	-	-	-	-	1.0	1.0	5.0	5.0	9.0	9.0
3 O.P.	2.0	3.0	11.0	11.0	-	-	6.0	6.0	1.0	1.0	7.0	7.0	27.0	28.0
3 Lect x 2	-	-	2.0	2.0	-	-	-	-	-	-	5.0	5.0	7.0	7.0
4 N.U.	6.0	14.0	11.0	11.0	10.0	14.0	6.0	6.0	3.0	3.0	5.0	5.0	41.0	53.0
3 Vedning 1	-	-	5.0	5.0	-	-	-	-	-	-	5.0	5.0	10.0	10.0
2 Vending 2	-	-	5.0	5.0	-	-	-	-	-	-	5.0	5.0	10.0	10.0
													177.0	200.0
													851.0	1048.0

Total trips In and Out	System A	System B
	1615.2	1961.2

Completion of

STEP 5 DELIVERY SCHEDULE

CORE SERV. AND	Food		Admin Sp Hskfg Sp		Ster Sp Med&Gen		Para Md		Drug Sp		Lin-Unif		Med Rec Paperwk		Total	
INPATIENT	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
B Lckrs-Hskpng	-	-	.2	.2	-	-	-	-	-	-	1.0	1.0	5.0	5.0	6.2	6.2
1 Admin	-	-	.2	.2	-	-	-	-	-	-	-	-	5.0	5.0	5.2	5.2
1 Rad Ther	-	-	.2	.2	1.0	1.0	-	-	2.2	2.2	1.0	1.0	5.0	5.0	9.4	9.4
1 Med Comm	-	-	.2	.2	-	-	-	-	-	-	-	-	5.0	5.0	5.2	5.2
1 Emerg	5.0	7.0	.2	.2	22.0	22.0	8.0	8.0	2.2	2.2	3.0	4.0	5.0	5.0	45.4	48.4
I Clin Labs	-	-	.2	.2	1.0	1.0	-	-	.2	.2	1.0	1.0	5.0	5.0	7.4	7.4
2 Mgt Admin	3.0	5.0	.2	.2	-	-	-	-	-	-	-	-	5.0	5.0	8.2	10.2
2 Patient Proc	-	-	.2	.2	.2	.2	-	-	-	-	-	-	5.0	5.0	5.4	5.4
2 Admin	-	-	.2	.2	-	-	-	-	-	-	-	-	5.0	5.0	5.2	5.2
2 Lib	-	-	.2	.2	-	-	-	-	-	-	-	-	5.0	5.0	5.2	5.2
3 Inhal ther	-	-	.2	.2	1.0	1.0	-	-	2.2	2.2	1.0	1.0	5.0	5.0	9.4	9.4
3 Hum func lab	-	-	.2	.2	1.0	1.0	-	-	2.2	2.2	1.0	1.0	5.0	5.0	9.4	9.4
3 Rad nuc med	-	-	.2	.2	1.0	1.0	-	-	2.2	2.2	1.0	1.0	5.0	5.0	9.4	9.4
3 Rad diag	-	-	.2	.2	1.0	1.0	-	-	2.2	2.2	1.0	1.0	5.0	5.0	9.4	9.4
3 Rehab	-	-	.2	.2	1.0	1.0	1.0	1.0	2.2	2.2	2.0	3.0	5.0	5.0	11.4	12.4
4 Deliv	-	-	1.0	1.0	16.5	16.5	1.0	1.0	2.2	2.2	1.0	1.0	5.0	5.0	26.7	26.7
4 Surgery	-	-	1.0	1.0	104.0	104.0	1.0	1.0	2.2	2.2	4.0	7.0	5.0	5.0	117.2	120.2
5 Restaurant	40.0	66.0	2.8	2.8	-	-	-	-	-	-	1.0	1.0	5.0	5.0	48.8	74.8
6 O.P.	-	-	.2	.2	1.0	1.0	-	-	2.2	2.2	2.0	3.0	47.0	47.0	52.4	53.4
7+Inpatient 1	140.0	196.0	2.8	2.8	42.0	42.0	23.0	23.0	30.8	30.8	44.0	84.0	5.0	5.0	287.6	287.6
7+Inpatient 2	140.0	196.0	2.8	2.8	42.0	42.0	23.0	23.0	30.8	30.8	44.0	84.0	5.0	5.0	287.6	287.6
															972.1	1200.1
OUTPATIENT																
1 Admissions	-	-	.2	.2	-	-	-	-	-	-	-	-	38.0	38.0	38.2	38.2
1 Amb Rec	-	-	.2	.2	-	-	1.0	1.0	-	-	-	-	5.0	5.0	6.2	6.2
1 Lobby info	-	-	.2	.2	-	-	-	-	-	-	-	-	5.0	5.0	5.2	5.2
2 O.P.	-	-	.2	.2	1.0	1.0	-	-	2.2	2.2	1.0	2.0	31.0	31.0	35.4	36.4
2 Pharm-shp	-	-	.2	.2	1.0	1.0	-	-	2.2	2.2	-	-	5.0	5.0	8.4	8.4
2 O.P.	-	-	.2	.2	1.0	1.0	-	-	2.2	2.2	1.0	2.0	31.0	31.0	35.4	36.4
3 O.P.	-	-	.2	.2	1.0	1.0	-	-	2.2	2.2	1.0	2.0	31.0	31.0	35.4	36.4
3 Lect x 2	-	-	.2	.2	-	-	-	-	-	-	-	-	5.0	5.0	5.2	5.2
3 Coffee shop	13.0	22.0	.2	.2	-	-	-	-	-	-	-	-	5.0	5.0	18.2	27.2
3 Lect	-	-	.2	.2	-	-	-	-	-	-	-	-	5.0	5.0	5.2	5.2
3 O.P.	-	-	.2	.2	1.0	1.0	-	-	2.2	2.2	1.0	2.0	31.0	31.0	35.4	36.4
4 N.U.	10.0	14.0	2.2	2.2	3.0	3.0	2.0	2.0	2.2	2.2	3.0	7.0	5.0	5.0	27.4	35.4
4 O.P.	-	-	.2	.2	1.0	1.0	-	-	2.2	2.2	1.0	2.0	31.0	31.0	35.4	36.4
3 Vending 1	4.0	4.0	.2	.2	-	-	-	-	-	-	-	-	5.0	5.0	9.2	9.2
2 Vending 2	4.0	4.0	.2	.2	-	-	-	-	-	-	-	-	5.0	5.0	9.2	9.2
															319.4	331.4
															1291.5	1531.5

Diagram 2 (Page 3 of 4)

CORE SERV. AND	Linen		Trash		Dishes		Spec		Reproc		Paperwk		Total	
INPATIENT	A	B	A	B	A	B	A	B	A	B	A	B	A	B
B Lckrs-Hskpng	1.0	2.0	8.0	8.0	-	-	-	-	-	-	5.0	5.0	14.0	15.0
1 Admin	-	-	2.0	2.0	-	-	-	-	-	-	5.0	5.0	7.0	7.0
1 Rad Ther	1.0	1.0	3.0	3.0	-	-	-	-	1.0	1.0	5.0	5.0	10.0	10.0
1 Med Comm	-	-	2.0	2.0	-	-	-	-	-	-	5.0	5.0	7.0	7.0
1 Emerg	5.0	7.0	12.0	12.0	5.0	7.0	6.0	6.0	7.0	7.0	5.0	5.0	40.0	44.0
1 Clin Labs	1.0	1.0	18.0	18.0	-	-	-	-	1.0	1.0	5.0	5.0	25.0	25.0
2 Mgt Admin	-	-	5.0	5.0	3.0	5.0	-	-	-	-	5.0	5.0	13.0	15.0
2 Patient Proc	-	-	14.0	14.0	-	-	-	-	-	-	5.0	5.0	19.0	19.0
2 Admin	-	-	2.0	2.0	-	-	-	-	-	-	5.0	5.0	7.0	7.0
2 Lib	-	-	2.0	2.0	-	-	-	-	-	-	5.0	5.0	7.0	7.0
3 Inhal ther	1.0	1.0	3.0	3.0	-	-	-	-	1.0	1.0	5.0	5.0	10.0	10.0
3 Hum func lab	1.0	1.0	7.0	7.0	-	-	-	-	1.0	1.0	5.0	5.0	19.0	19.0
3 Rad nuc med	1.0	1.0	3.0	3.0	-	-	-	-	1.0	1.0	5.0	5.0	10.0	10.0
3 Rad diag	2.0	2.0	3.0	3.0	-	-	-	-	1.0	1.0	5.0	5.0	11.0	11.0
3 Rehab	3.0	6.0	6.0	6.0	-	-	-	-	1.0	1.0	5.0	5.0	15.0	18.0
4 Deliv	2.0	2.0	4.0	4.0	-	-	-	-	14.5	14.5	5.0	5.0	25.5	25.5
4 Surgery	8.0	14.0	5.0	5.0	-	-	6.0	6.0	79.0	79.0	5.0	5.0	103.0	109.0
5 Restaurant	1.0	1.0	5.0	5.0	40.0	66.0	-	-	-	-	5.0	5.0	51.0	77.0
6 O.P.	3.0	5.0	11.0	11.0		-	6.0	6.0	1.0	1.0	7.0	7.0	28.0	30.0
7+Inpatient 1	88.0	168.0	56.0	56.0	140.0	196.0	84.0	84.0	28.0	28.0	5.0	5.0	401.0	537.0
7+Inpatient 2	88.0	168.0	56.0	56.0	140.0	196.0	84.0	84.0	28.0	28.0	5.0	5.0	401.0	537.0
													1218.5	1524.5
OUTPATIENT														
1 Admissions	-	-	-	-	-	-	-	-	-	-	5.0	5.0	5.0	5.0
1 Amb Rec	-	-	-	-	-	-	-	-	-	-	5.0	5.0	5.0	5.0
1 Lobby info	-	-	1.0	1.0	-	-	-	-	-	-	5.0	5.0	6.0	6.0
2 O.P.	2.0	3.0	11.0	11.0	-	-	6.0	6.0	1.0	1.0	7.0	7.0	27.0	28.0
2 Pharm-shp	-	-	3.0	3.0	-	-	-	-	1.0	1.0	5.0	5.0	9.0	9.0
2 O.P.	2.0	3.0	11.0	11.0	-	-	6.0	6.0	1.0	1.0	7.0	7.0	27.0	28.0
3 O.P.	2.0	3.0	11.0	11.0	-	-	6.0	6.0	1.0	1.0	7.0	7.0	27.0	28.0
3 Lect x 2	-	-	2.0	2.0	-	-	-	-	-	-	5.0	5.0	7.0	7.0
3 Coffee shop	-	-	5.0	5.0	13.0	22.0	-	-	-	-	5.0	5.0	23.0	32.0
3 Lect	-	-	2.0	2.0	-	-	-	-	-	-	5.0	5.0	7.0	7.0
3 O.P.	2.0	3.0	11.0	11.0	-	-	6.0	6.0	1.0	1.0	7.0	7.0	27.0	28.0
4 N.U.	6.0	14.0	11.0	11.0	10.0	14.0	6.0	6.0	3.0	3.0	5.0	5.0	41.0	53.0
4 O.P.	2.0	3.0	11.0	11.0	-	-	6.0	6.0	1.0	1.0	7.0	7.0	27.0	28.0
3 Vending 1	-	-	5.0	5.0	-	-	-	-	-	-	5.0	5.0	10.0	10.0
2 Vending 2	-	-	5.0	5.0	-	-	-	-	-	-	5.05	5.0	10.0	10.0
													258.0	284.0
													1476.5	1808.5

TOTAL TRIPS In and Out	SYSTEM A	SYSTEM B
	2768.0	3340.0

Diagram 2 (Page 4 of 4)

The selection of a system should be made on the basis of its performance potential in relation to the organizational and architectural environments it supports. It is noted in Section 1.0, and emphasized in Section 1.3.1 that either of the system discussed offers substantial annual operating economies. For very gross estimating purposes one might assume that an initial capital investment of two per cent of construction construction cost could yield an annual saving of one per cent of operating cost with which to amortize it.

In general the logistics organization should be designed to handle these loads in standard working days. The Service Building should operate all departments except decontamination and distribution in an eight hour day. These latter departments should operate two shifts and the night shift should have only a skeleton staff competent to issue identified, packaged items from the assembly area.

In inpatient care areas two full shifts of logistics technicians, though they may differ in number, should be provided, with one technician serving each inpatient floor on the night shift. All major deliveries and returns should occur within 16 hours.

In most other areas the logistics technician's job is a fractional part of a day. It may be subsumed by other personnel, as in surgery, or it may be handled by scheduled, short term work periods during the day.

The outbound and inbound loads on the main pathways are estimated as follows:

AVERAGE CARS/HOUR 16 HOUR DAY	STEP 4		STEP 5	
	Delivery	Pickup	Delivery	Pickup
AMSCAR	48	53	81	93
CYBERAIL	57	66	96	113

These data indicate that special design consideration must be given to the distribution center. The car queuing area, the main exitway, the south trunk and perhaps, for Amscar, some queueing areas at elevator entry points on the systems floor in the main block.

If we assume that the distribution capacity of a single shaft operating at 75% efficiency is 30 trips per hour for the Amscar and 225 trips per hour for Cyberail, it is apparent that Amscar will require four vertical risers and that Cyberail will require one in Step 4. In Step 5 Amscar will require 6 risers and Cyberail one. It is possible that on final analysis one Cyberail riser would suffice, but the wisdom of depending on a single riser for such a heavy workload is questionable in view of possible down time for maintenance and repair.

1.3 MECHANICAL SYSTEMS CONSIDERED

The basic systems currently available for moving materials in the volume and time spans required for the 1300 bed hospital shown in Step 5 of the Master Plan have already been described in the special report of Chas. T. Main, Inc., included in the LGAI Report. The choices are easily narrowed down by a review of load factors, an estimate of manhour requirements of manual operation, an examination of capacities of currently available systems and consideration of the flexibility goals of the architecture

1.3.1 MANHOUR REQUIREMENTS

The estimate of total logistics trips per 24 hours is, in round figures, 3000 at Step 5. The mean, weighted average travel time for a man walking without interruption and pushing a vehicle to the median distance of the areas served on the main block is calculated conservatively as 3.64 minutes per trip. This is translatable to 182 man hours per day assuming that each outbound trip is immediately succeeded by a loaded inbound trip, an assumption that will be tempered in the following assessment of a man's usable time.

A full year's job demand is 365 days x 8 hours = 2920 hours. A man's work year, allowing for two weeks' vacation and ten holidays is 1920 hours. Thus 34% (1000/2920) of the job is excess to his work day. Also the man on a job of this kind should receive 15 minute breaks morning and afternoon and a 5 minute rest period for each hour not served by a break. It adds up to this:

One effective man day = 8.00 hours

Less 34% = 2.72 hours

Less two 15 minute breaks, six 5 minute rests = 1.00 hour
Net workday remaining + 4.28 hours

This figure, applied to the 182 man hour work load for movement from the Service Building to use points, shows a demand for 42.5 positions; but it cannot be assumed that every outbound trip will be matched by a useful inbound trip. If, instead, it is assumed that the man can be 75% efficient in his two way travel, his net work day drops to 3.21 hours. At this efficiency level the 182 man hour work load requires 56.8 staff positions.

Such men are estimated to cost today about seven thousand dollars a year each, including recruitment and training cost; so the labor cost of a manual system, excluding construction of horizontal and vertical pathways and equipment, approximates $400,000 per year. At Step 4, with 2000 trips per day in the newly constructed building, the labor cost differential approximates $265,000.00.

It must be noted in this latter case that delivery and return demands will continue to be exerted by the existing occupied buildings. These demands are approximately 1000 per day that will presumable continue to be met in the ways they are met currently. Inasmuch as the mechanized pathway to the new structures will pass immediately adjacent to the Mallory Building, consideration should be given to establishing a station at that point. The continuing exchange of laboratory specimens between the new structures and Mallory will otherwise require a costly shuttling of personnel.

1.3.2 AVAILABLE SYSTEMS AND RECOMMENDATIONS

The variety of systems available permits any portion of the travel linkage to be operated with or without attendants. Fully automated systems eliminate the most labor and also eliminate the most opportunity for human failure in controlling direction of traffic to its destination. Costs are also important in a heavily loaded system. An elevator, manned, costs about $80,000. The operator costs about $7,000 a year. The same elevator,automated to receive and eject carriers costs about $95,000.

A man driving trains of four self directing carriers each back and forth between the Service Building and the vertical risers could cut the daily horizontal travel from 3000 trips to 750. Each trip would require about 2.5 minutes plus 1 minute of unhitching and hitching time. A loader for each riser and a dispatcher at the Service Building would be required to supplement his effort by aligning cars for elevators and aligning them for hitching. Such a system at 75% efficiency would require seven elevators and 54 staff

positions assuming the elevators accept and eject carts automatically. If the elevators are not so automated, the staff demand would increase by at least another 35 people and elevator inefficiency might add further costs.

An Amscar system would use the same number of elevators at the same cost per elevator. It would require the same 182 work hours for delivery and collection since its maximum horizontal speed approximates that of a man pushing a cart; it will experience the same 75% loading efficiency;but it doesn't take vacations, holidays or breaks, so its availability is limited only by recharging. Current battery replacement packs are being developed which will eliminate charging time. An Amscar day, available at 75% efficiency would offer in 12 hours nine hours of work. The 182 hour work load would require 20 Amscar power units at an estimated capital cost of $6,500 each. This is clearly less expensive than employing the equivalent manpower discussed above. This does not infer that only 20 cars would be needed - the vertical, continuing trip would demand more carrier time. The comparison applies only to the horizontal component.

A Cyberail system can deliver between 250 and 500 carriers between source and use points per hour depending on configuration and handling. It can be used on the horizontal linkage, only, to replace 53 of the 54 men cited above in delivering automated carriers to an automated elevator system, or it can be used horizontally and vertically to reach ultimate destinations. It is a continuous, nonreciprocating system. In the proposed Boston City Hospital architecture with its open systems floors between floors the Cyberail System can be routed from its vertical shaftway to any point at any level in the hospital and drop down or move up to a local station without penetrating other occupied space. Over time the stations can be relocated at will. It is generally considered to be slightly more expensive in initial cost than the Amscar System but this has not always proven true in competitive bidding. In a study for the Tufts-New England Medical Center* it was demonstrated that its cumulativecost over a forty year period would be substantially less than that of Amscar and that either of these fully automated systems would cost very much less than a semi-manual system.

*Souder, Clark and Associates, Chas. T. Main, Inc. "Economic Comparison of Proposed Materials Handling Systems, Tufts-New England Medical Center", August, 1968

The long range economy of total outlay for Cyberail over Amscar in this instance was based on estimates of first cost, maintenance cost, parts replacement and seven per cent interest cost of invested funds, plus an assumed inflation of 4% per year. The initial cost for either system was estimated to be about twice that of the equipment needed for a manual system, but the annual labor savings were estimated to repay the investment in six to six and one half years of operation.

The operating characteristics of Amscar and Cyberail are substantially different. Amscar requires reciprocal vertical movement in elevators but can move freely on any prescribed horizontal pathway and these pathways are easily changed or extended. Practically, no one has attempted to move self powered Amscar units through public corridors unattended even though safety devices preclude collisions. Psychologically it is a little like the early horseless carriage in the public mind. It could move at will through the system floors at B.C.H. but at every change to vertical direction it would require an elevator and encounter a factor of waiting time; therefore a design which requires horizontal transfer of Amscars from one vertical shaft to another exacts penalty from hourly system capacity. Cyberrail moves on overhead metal track horizontally and vertically, without interruption, on a continuous loop provided with switches to offload conveyors at terminals. Its mechanical and electronic sophistication probably - though it has not yet been proven in practice - require more maintenance time and skill than the Amscar System and its horizontal pathways are more costly to relocate or extend.

Also, the Amscar carrier is more adaptable to dimensional variation of loads: it is merely a powered platform that can carry objects as high as the doorheads it passes through. The Cyberail carrier is a closed box of fixed dimensions with an overhead transporter that does not tolerate other dimensions.

It is recommended that a fully automated system be used for the Boston City Hospital. At the present time Cyberail is the system of choice. Between now and the letting of contracts it is possible that the state of the art and competition will offer wider choices, but in either event a system offering Cyberail's carrying capacity and flexibility for rerouting in the system floor arrangement seems clearly superior to other systems.

There will be need for supplemental materials handling equipment, particularly in the Service Building. As a general rule, however, redundancy of systems should be avoided. For example, pneumatic linen and trash chutes, which may prove useful in the Service Building, would replicate the major systems capabilities in the hospital proper and add handling costs since materials would have to be collected locally in use areas, carried to chute stations and fed to the chute whereas an all purpose container parked in the use area need only be taken to railhead and dialed to its destination.

Pneumatic tubes will be an essential part of the information carrying service both vertically and horizontally in the decentralized nursing-unit managers concept. It is highly probable that computer based information handling systems will very soon offer a faster and far more useful information transfer, storage and retrieval service than the pneumatic tube; so the tube should be regarded as an interim tool.

Another interesting supplemental system is Mosler Telelift, a small scale counterpart of Cyberail that has greater carrying capacity in both volume and character of items than the pneumatic tube. It is easily reroutable when architectural changes are made and if its design development produces simplified terminals less costly than today's, it could conceivable provide economic delivery service to small use areas such as the patient room or remote nursing command post.

Finally, it should be noted that in addition to automated systems service elevators will be needed to move furniture, equipment, mechanical replacements, etc. Since plant maintenance is located in the Service Building, the Albany Street bridge or bridges should be sized to handle men with maintenance vehicles as well as automated conveyors.

1.3.3 IMPLICATIONS FOR PHYSICAL DESIGN

The clear span structure and system floors proposed in the Master Plan offer exceptional opportunity to take maximum advantage of an appropriate automated delivery system.

In initial planning and in planning future change every structural intrusion, be it column, pipe chase or hoistway, inhibits the search for optimal arrangement of spaces. Supply systems, which must relate to specific activities within departments, can become severe constraints on departmental design; therefore, a supply system using a minimal number of vertical risers and given the opportunity to reach out from the risers through systems floor space to points directly above or directly below the optimal positions in the departments it serves offers unusual flexibility. In concept such a system can provide downfeed or upfeed to local termini wherever they are needed.

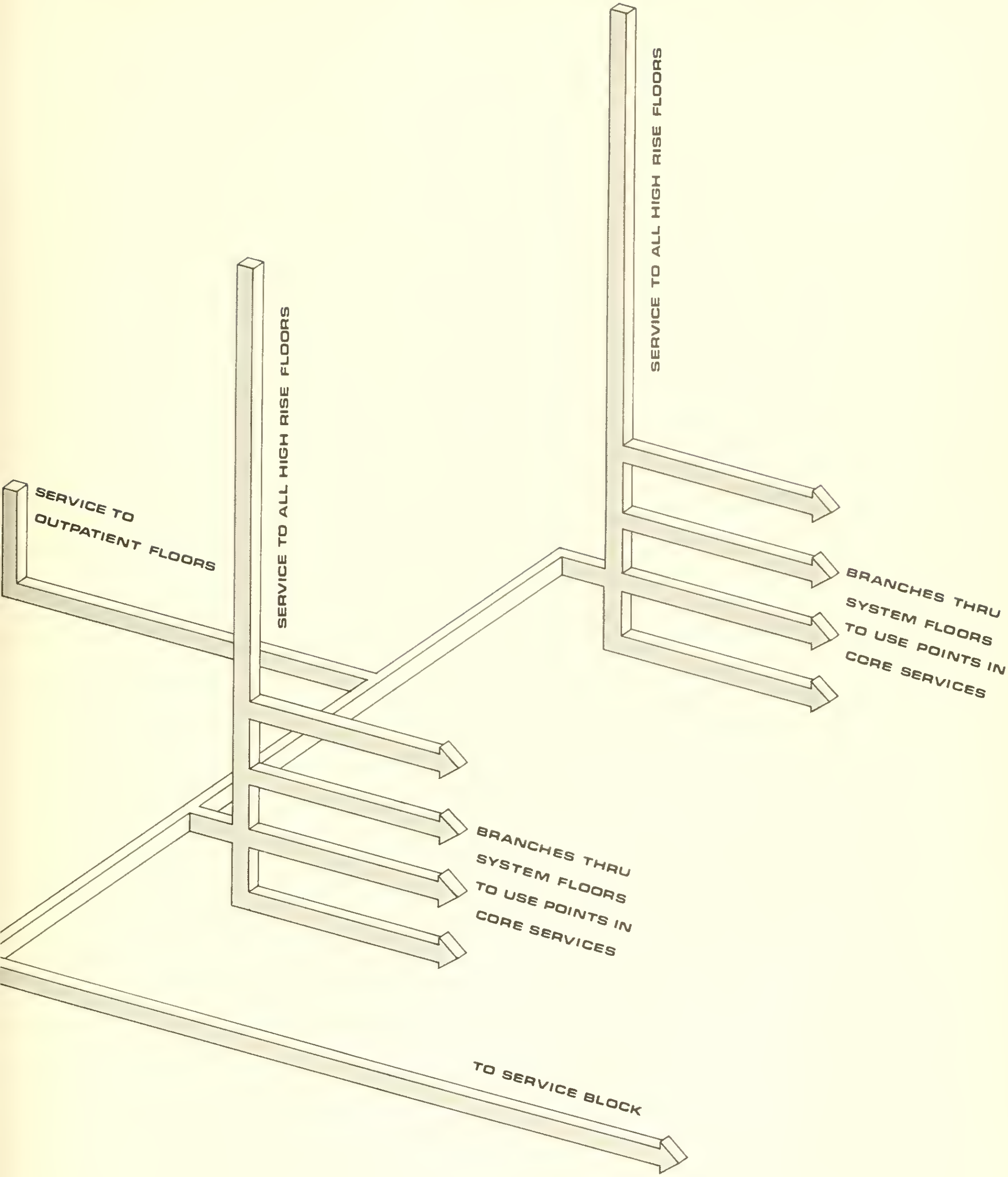
This advantage is most pronounced in a system like Cyberail whose downfeed and upfeed components need penetrate no further than the spaces they serve. Systems that use elevators present the difficulty of requiring machine rooms above and pits below; so their applications are less flexible.

The current Master Plan indicates three supply system risers in the Core Services building, one in the Outpatient Buildind and two in the High Rise Building, or a total of six fixed vertical shaftways each of which related to the main horizontal pathway from the Service Block at level 2. The stations shown in the Core Services Building in most cases serve more than one department. For those cases the transport carriers would have to be moved laterally and manually through public circulation from the stations to their ultimate use points.

According to the load estimates in Section 1.2 one Cyberail riser could handle the total traffic; however, it would be prudent to provide redundant pathways in order to allow for maintenance or breakdown. Given two main risers, then, located where they interfere least with internal departmental layout, branches of the supply system could be fed laterally through the systems floors in the Core Services and Outpatient Buildings to desired terminal locations. The two risers could continue upward to serve the High Rise Building.

In such a two riser system special design attention should be directed to the problems inherent in phasing steps 4 and 5. At completion of step 4 only one riser would exist and redundancy would be unattainable. There exists the possibility that a local riser could be placed in either the Outpatient Building or the Core Services Building and tied laterally to the first High Rise riser in order to assure redundancy at least through level 4.

Should future alteration suggest different terminal locations, the horizontal trackage could be re-routed as desired if initial layout of mechanical services in the systems floors is designed not to conflict with such rearrangement. Cursory inspection of possible routings for the vertical and horizontal trackage suggests that its length should not exceed that of the multiple riser design.


SERVICE TO ALL HIGH RISE FLOORS
SERVICE TO ALL HIGH RISE FLOORS
SERVICE TO OUTPATIENT FLOORS
BRANCHES THRU SYSTEM FLOORS TO USE POINTS IN CORE SERVICES
BRANCHES THRU SYSTEM FLOORS TO USE POINTS IN CORE SERVICES
TO SERVICE BLOCK

MATERIALS HANDLING SYSTEMS

DIAGRAM 3

APPENDIX A

DEFINITIONS OF SUPPLY CATEGORIES

ADMINISTRATIVE:	Forms, office supplies
DISHES:	Used Food Service. If disposable dishes and cutlery are used, they are classed as trash for pickup. Non disposable dishes and cutlery in dining rooms remote from kitchen are assumed to be washed and stored at the dining point; inventory replacement in that case is classed as general supply.
DRUGS:	Bulk supplies delivered to preparation and dispensing points, stat orders to dispensing points, and stat orders to treatment points from central pharmacy during hours when outlying dispensing points are not staffed.
FOOD:	Prepared food, delivered in carts to inpatient nursing on trays assembled in the main kitchen and prepared food delivered in bulk unit containers to dining rooms from the main kitchen.
HOUSEKEEPING:	Cleaning supplies, paper supplies and equipment for routine use. Bulk supplies, such as drums of cleaning agents are not included nor are large equipment items such as floor polishing machines, which are assumed to be moved to work site by personnel rather than being transported unattended. It includes admission kits.

LINEN, UNIFORMS:	Bed linen, surgical linen, personal linen for patients and staff, clean or soiled. Discharge packs, blankets and pillows are included.
MEDICAL, GENERAL:	Minor treatment supply such as adhesive, tongue depressors, thermoeters, applicators, gauze, cotton, safety pins, etc.; also scissors, flashlights, specimen containers, disposable trays and cups; also, laboratory supplies, external solutions, teaching aids, hot water bottles, ice collars.
PAPERWORK:	Action notices, reports, medical records, mail, memoranda, manuals, journals, books. Packages and flowers for patients are included in this category.
PARAMEDICAL:	Sandbags, crutches, suction equipment, frames, walkers, wheelchairs, bed attachments, atomizers, croupettes and similar treatment related equipment.
REPROCESSIBLES:	Soiled sterile supply items enroute to reprocessing.
SPECIMENS:	Material taken from patients by nursing or laboratory personnel for laboratory analysis.
STERILE SUPPLY:	Sterile disposables and reprocessable items that require cleaning wrapping and sterilization between uses. Included are instruments, surgical and obstetrical packs, sterile trays and sets, surgical linen, bedside sets.
TRASH:	Non salvagable used materials excluding furniture and equipment.

NOTES: 1. Furniture and equipment are excluded as supply items on the assumption that their transit requires manned attendance rather than automated conveyance.

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SUPPLEMENTARY REPORT
OUTPATIENT BUILDING
BOSTON CITY HOSPITAL

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MASTER PLAN BOSTON CITY HOSPITAL

SUPPLEMENTARY REPORT
OUTPATIENT BUILDING

Prepared by:

HUGH STUBBINS/REX ALLEN PARTNERSHIP

November, 1969

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Hugh Stubbins / Rex Allen Partnership

November 14, 1969

Mr. Robert T. Kenney,
Director
Public Facilities Department of
City of Boston
1 City Hall Square
Boston, Massachusetts 02201

Dear Mr. Kenney:

We are pleased to submit this addendum to the Master Plan for Boston City Hospital entitled "Supplementary Report - Outpatient Building." This is done in accordance with the request of the Public Facilities Department, contained in your letter of August 7, 1969.

The report illustrates the feasibility of integrating the Outpatient Building with the residence facilities in the South Block and the need for close coordination of programming, planning and design efforts.

We hope the information contained herein will be useful in the implementation of the reconstruction of Boston City Hospital.

Very truly yours,

HUGH STUBBINS/REX ALLEN PARTNERSHIP

Hugh Stubbins, FAIA   Rex Whitaker Allen, FAIA

PAZ/rh

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PREFACE

Subsequent to the presentation to the Public Facilities Department of the Master Plan in June, 1969, and a period of review by the Department, the Hugh Stubbins/Rex Allen Partnership was asked to consider the implications of moving all or part of the programmed area for the outpatient clinics and doctors' offices to the portion of the South Block that borders Massachusetts Avenue. This stemmed from the PFD's desire to:

1. More fully integrate the South Block planning with the overall master planning for the remainder of the complex.
2. More closely relate its functions, services, and systems with those of the Hospital, now and in the future.
3. Construct the maximum capacity of patient or public related spaces during the early steps of the reconstruction.
4. Accomplish this in a short period of time.

This supplementary report was begun in August, 1969, to study whether these goals could be achieved, and if so, the best manner to do so. The Partnership's efforts include the following areas of work:

1. Analysis of the relationship of an Outpatient Building located on the northern portion of the South Block to the Main Block Hospital and East Block Service Building.
2. Study of resulting traffic patterns, revised entry and arrival systems, and interior circulation.
3. Study the effect of the revised location on structural and mechanical systems.
4. Study revised construction phasing for entire project and subsequent changes in costs.

The following report presents the results of the study.

Only those aspects of the Master Plan related to the outpatient and doctors' offices have been revised and are discussed in this supplementary report. All other sections of the Master Plan still apply.

The following documents now comprise the Master Plan for Boston City Hospital:

Master Plan for Boston City Hospital,
June 1969

Supplementary Report - Materials Handling System,
October 1969

Supplementary Report - Outpatient Building,
November 1969

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Note: Included in the list of illustrations are the diagrams necessary to illustrate the revised design of the Outpatient Building. All other diagrams remain substantially the same, as presented in the Master Plan, dated June, 1969.

1.0 SUMMARY

As a prerequisite to the development of a viable alternate concept for the Outpatient Building the Partnership assessed the proposed plans on both sides of Massachusetts Avenue. Since a merger of the two complexes was implied in any new concept, their similarities and dissimilarities were determined. The program goals and design criteria that predicated the design for the building shown in the Master Plan dated June, 1969, were re-examined.

The program developed by Lester Gorsline Associates, International originally called for the outpatient clinics and doctors' offices to be an integral part of the Hospital complex, to the extent of suggesting that they be mixed with inpatient units. Due to the large number of outpatient visits and the resulting cross traffic and confusion this could cause on the inpatient floors, the concept was modified. However, the intent of the program, that the whole complex be conceived as one entity rather than a conglomeration of decentralized buildings and functions, was incorporated into the Master Plan.

In the June, 1969 Master Plan the outpatient department was linked to core services and inpatient areas through a connecting element, the concourse. Its vertical transportation, structural, mechanical/electrical, and communications systems were integral with or extensions of those of the Hospital.

The 4-story structure, like the remainder of the Hospital, was a structural steel frame with long span steel trusses to provide maximum flexibility. Mechanical and electrical services came from the central power plant on the East Block and supply support was via an automated supply system originating on the East Block.

The South Block complex across Massachusetts Avenue contained housing for student nurses, married interns, the nurses school, and parking. The complex was designed to a different program, as a separate entity. Therefore, the structures designed around an apartment unit planning module were short span, reinforced concrete with low 8'-8" floor to floor heights.

The relatively simple and uncomplicated mechanical services came from two mechanical rooms located in building #4 at the corner of Albany Street and Northampton Street. No automated supply system was planned.

The program and design criterion re-evaluation indicated that any new plan should incorporate or resolve the following major design considerations:

1. Centralization of the triage, admitting clinic, emergency entities. The program envisioned that every patient arrival at the Hospital be seen in traige by an intern or doctor, that a rough diagnosis of his condition be made, and that the patient be directed to the outpatient clinics, emergency department, or inpatient areas. The contiguous single-level relationship established in the Master Plan for these entities should be retained.

2. The outpatient clinics have heavy supply requirements (see Supplementary Materials Handling Report) which approximate 20% of the total daily load of the Hospital. Therefore, the materials handling system supplying the High-Rise and Core Services Building should supply the Outpatient Building as well.

3. The mechanical requirements of the variety of specialized clinics and doctors' offices are extensive. The complexity of the mechanical, electrical, and communications systems require deep mechanical/ electrical spaces over each use level.

4. The 8'-8" floor to floor heights of the South Block structures would not provide the mechanical space that is required.

5. The outpatient entity is an area of rapid change. Emerging new methods of providing medical care are affecting most the ambulatory care departments of a hospital. Therefore, many changes can be expected to occur and a high degree of flexibility should be provided.

6. The floor elevations of the new Outpatient Building should line through with those of the Core Services Building to permit easy transport of persons in wheelchairs, guerneys, etc.

7. The advantages of shared use of the elevator banks, and convenient access to the inpatient areas for staff from the outpatient areas should be retained as much as possible.

A thorough analysis of these design considerations showed that only a limited number of alternate solutions had merit. These were developed simultaneously and their individual cost and schedule implications were investigated.

Design studies and descriptive data were presented to the PFD for review at a design-in* September 8-9, 1969. These concepts were:

Concept A	Outpatient Building totally contained on the South Block with the nurses housing and school partially redesigned.
Concept B	Outpatient Building totally contained on the South Block with the nurses housing and school relocated to the Main Block.
Concept C	Outpatient Building built over Massachusetts Avenue on air-rights.
Concept D	Master plan concept, as submitted in June, 1969.

At the design-in it was determined that Concept C held many strong points and that the study of that concept should be continued. Subsequent efforts and decisions led to a variant of that concept, in which approximately 50% of the outpatient clinics and doctors' offices were taken out of the air-rights construction and placed on the South Block, above the plaza.

* The working documents used in these discussions are included as Appendix B.

The new configuration of the Outpatient Building will be a four-story structure with basement on the Main Block, between Vose House and Dowling Building, which extends over Massachusetts Avenue in a three-story air-rights link, and terminates in a three-story element on the South Block. This concept, described in more detail in the sections following this summary, has the following advantages:

1. The functional relationship between outpatients, triage, admitting clinic, and emergency remain the same as in the Master Plan. For the areas above Massachusetts Avenue the relationship to core services is somewhat better than the Master Plan as the width of the building has been increased to 120 feet.

2. The concept permits the Outpatient Building to be built immediately on the parking area between Vose House and Dowling and over Massachusetts Avenue. Redesign of the South Block is minimal. Both projects may proceed simultaneously. Therefore the concept could start and be completed earlier than any other concept.

3. Internal circulation and vehicular access is similar to the Master Plan.

4. The development of a materials handling loop and a significant building link on several levels to the South Block will overcome the barrier of Massachusetts Avenue and permit the inclusion of the South Block buildings and spaces in future hospital planning on a closely integrated basis.

5. Second visit outpatients can park in the garage of the South Block and take conveniently located elevators to the clinics.

One significant aspect of the revision is that in the new scheme, although the entry system will remain essentially unchanged, the High-Rise structure can be moved southward. This will in turn allow the retention of Peabody Burnham and Wards FGH to a later date, than previously planned, and therefore eliminate the need for interim space on the East Block. If such space becomes necessary, it will be nominal and can be provided in existing buildings on the Main Block.

Mock-up Unit

The new concept does not make the construction of a 48-bed mock-up unit in the Outpatient Building feasible. The unit would be too remote on the South Block and not well located in the portion over Massachusetts Avenue. However, since this is an important unit for evaluation, it is recommended that a mock-up unit of a reduced number of beds be built in a portion of an existing building on the Main Block.

PLANNING IMPLEMENTATION

Two decisions made by the PFD will permit the completion of the Outpatient Building in a short period of time and are the basis of the following implementation schedules. These decisions are:

1. Early contracts will be let for foundations and frame of the new structures; while the contract documents for the remainder of the buildings are being finished. This method will save approximately $500,000 due to reduced escalation increases and, in addition, will compress the construction period and place income producing units into operation sooner.
2. When required by the construction sequence Vose House will be demolished and the resident nurses moved to Franklin Square House, a nearby residence hall. The school functions will be relocated to Boston City College High School.

A summary of the construction procedure for the implementation of Step 1 is shown in Section 3 of this report. However, many tasks must be accomplished prior to actual construction. In rough order of sequence, they are:

1. The initiation of design of the Outpatient Building in the parking lot between Vose House and Dowling Building, and over Massachusetts Avenue.
2. Initiation of the redesign of the South Block to incorporate those areas of the Outpatient Building to be built over the plaza.
3. Initiation of the design for the power plant to be constructed on the East Block to provide power and services and airconditioning capacity to the Outpatient Building.
4. A coordinated programming effort to finalize clinic locations, doctors' office groupings, etc.
5. Let contracts for the foundations of the South Block.

6. Let contracts for the foundations of the Outpatient Building and the power plant.
7. Relocate the existing primary switchgear to the East Block from its present location adjacent to Dowling.
8. Let contracts for the redesigned South Block.
9. Let contracts for the completion of the Outpatient Building and power plant.
10. Coordinate construction schedules so that completion of the two structures coincide.

The successful and fruitful realization of this program will require a high degree of coordination of the efforts by the master plan architects, Hugh Stubbins/ Rex Allen Partnership, and the South Block architects, Samuel Glaser & Partners, Architects.

Communications between the architects, their consultants, and directing bodies must be clear, direct, and open. Regular and frequent job schedule and job progress meetings should be held.

The rapid pace necessary to realize the schedule set forth will not be easy to maintain. That pace, however, is well suited to our inflationary times, and the great need of the people of Boston for these facilities.

CONSTRUCTION COSTS

The revised construction costs are less than those projected in the Master Plan. Anticipated savings are approximately $1.4 million at present costs and $1.8 million in total project costs. This is principally due to reductions in escalation costs through the construction of almost all programmed areas for outpatient and doctors' offices in Step 1 of the phasing, rather than the deferment of half of the construction to Step 5. Another contributing factor is the savings in escalation caused by acceleration of the construction period. This is achieved by letting foundation and frame contracts early.

The compilation of costs for each step and their comparison to figures in the Master Plan are as follows:

Summary of Construction Costs - Master Plan

Step	February 1969 Costs	Escal. Index	Escalated Bid Costs
1	$ 6,533,000	121.7	$7,950,700
2	6,765,300	129.3	8,747,500
3	9,415,500	132.1	12,434,000
4	36,633,600	127.5	46,707,800
5	43,981,000	144.8	63,684,500
6	1,670,400	154.0	2,572,400
	$104,998,800		$142,096,900

Summary of Construction Costs - Revised

Step	February 1969 Costs	Escal. Index	Escalated Bid Costs
1	$ 11,400,500	122.5	13,965,600
2	5,216,000	122.1	6,368,700
3	10,409,700	132.1	13,751,200
4	34,847,300	130.7	45,545,400
5	39,976,200	144.8	57,885,500
6	1,670,400	154.0	2,572,400
	$103,520,100		$140,088,800

Summary of Escalated Project Costs - Master Plan

Step 1	$ 9,757,000
Step 2	10,335,600
Step 3	15,087,900
Step 4	57,242,800
Step 5	77,955,400
Step 6	2,932,500
	$173,316,200

Revised Summary of Escalated Project Costs

Step 1	$ 17,207,200
Step 2	7,415,700
Step 3	16,739,200
Step 4	55,985,600
Step 5	71,238,200
Step 6	2,932,500
	$171,518,400

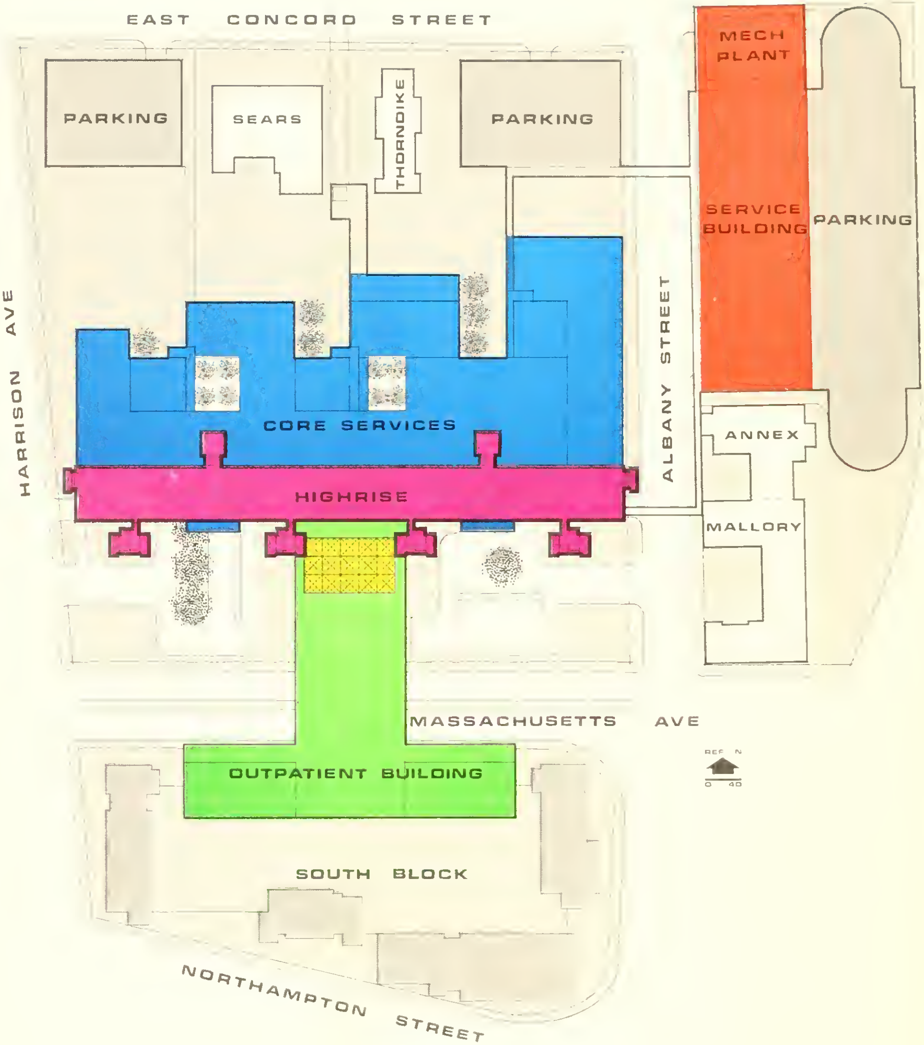
2.0 THE REVISED MASTER PLAN CONCEPT FOR THE OUTPATIENT BUILDING

The following is a brief review of the concept presented in the Master Plan, following which is a description of the modifications brought about by the revised design of the Outpatient Building.

In the Master Plan the functional units of the Hospital were grouped around the circulation system. This basic circulation system was housed in a 4-story concourse which accommodated and sorted the high volumes of internal traffic and at the same time provided the organizing network for the utility and supply distribution systems.

The major entities of the Hospital were arranged around this concourse in three buildings: to the north of the concourse the Core Services Building, a 5-story structure containing all the core service functions of the Hospital; above the concourse and connected to it by four banks of elevators the 15-story High-Rise, which contained inpatient services; to the south the linear 5-story Outpatient Building which connected to the elevator towers and Core Services by corridor links. With the exception of the Outpatient Building these aspects of the concept remain unchanged.

The Outpatient Building is now designed as a 5-story "T"-shaped building with its leg starting over the main lobby. It contains triage and admitting clinic, and spans Massachusetts Avenue in a 120' wide, 3-story air rights structure. The arms of the "T" extend east and west, adjacent to the plaza of the South Block's housing and nurses' school complex (see site plan diagram).


EAST CONCORD STREET
PARKING
SEARS
THORNDIKE
PARKING
MECH PLANT
SERVICE BUILDING
PARKING
HARRISON AVE
ALBANY STREET
CORE SERVICES
ANNEX
HIGHRISE
MALLORY
MASSACHUSETTS AVE
REF N
0 40
OUTPATIENT BUILDING
SOUTH BLOCK
NORTHAMPTON STREET

SITE PLAN

2.1 ENTRY AND ARRIVAL SYSTEM

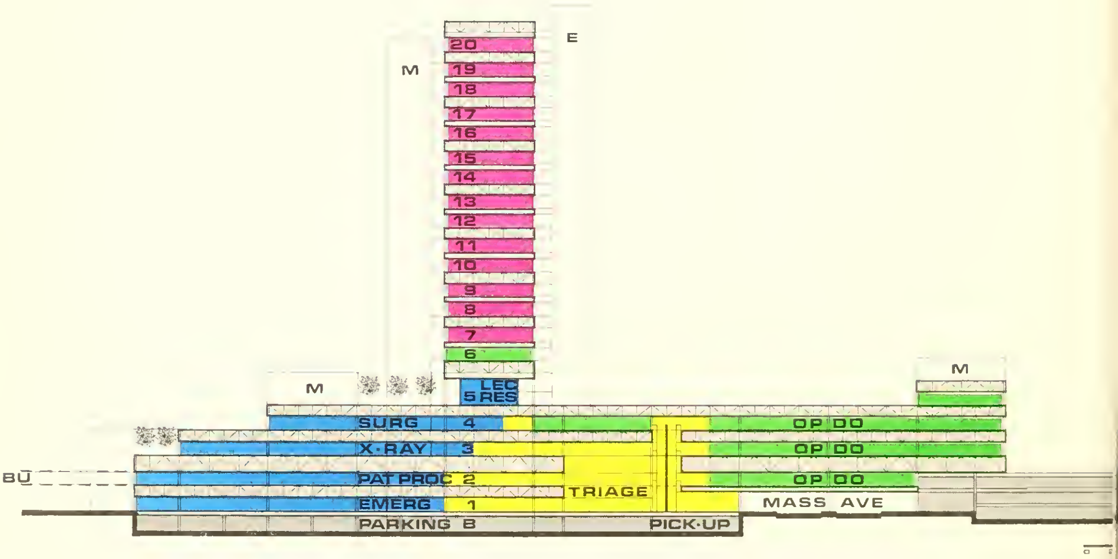
Two categories of outpatients arrive at the Hospital. First time arrivals go to the information/appointment area and are directed to admitting clinic, multiphasic or appropriate specialty clinic. Second visit arrivals who have appointments can be expected to find their way directly to a designated clinic.

First visit outpatients arriving as pedestrians, or via taxi will enter the main lobby from Massachusetts Avenue. Arrivals by car will use the Harrison Avenue entry at street level or drive directly to the underground parking area*, proceed from the garage pick-up to the main lobby, and then to the admitting clinic and/or information/appointment area, and the appropriate specialty clinic.

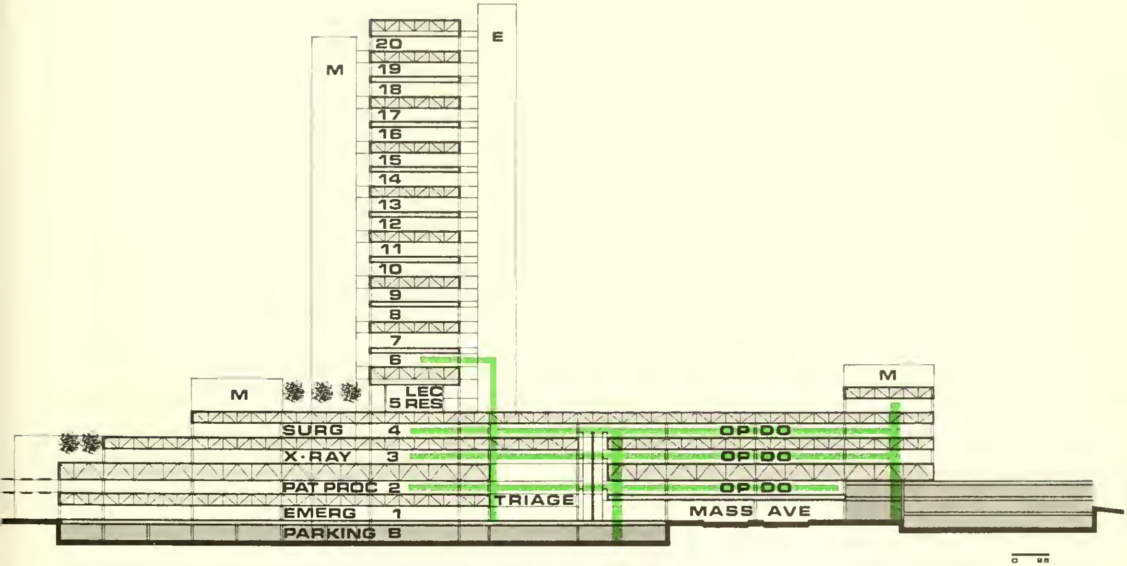
Second visit outpatients will have two choices of access. Persons with appointments can go directly from the parking garage in the Main Block, or other entry point, directly to the waiting area of the specialty clinic. If their clinic is located in the South Block, they may conveniently reach it from the parking structure in the South Block.

Separate entries to certain functions contained in the Outpatient Building that do not have strong links with the Hospital, such as Health Education, City Employee's Health Services, State VD program, etc., should be located in the area along the south side of Massachusetts Avenue.

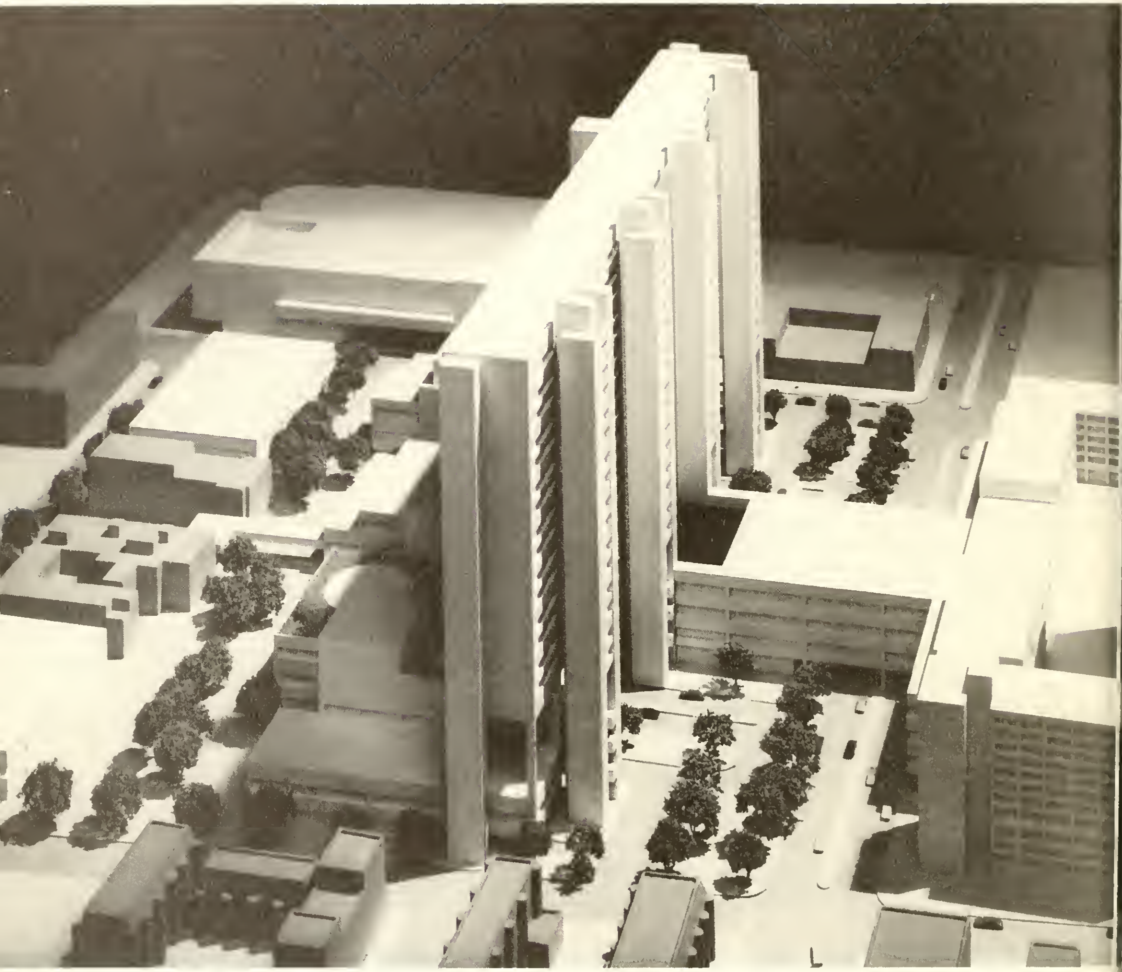
* Due to the high cost of temporary up and down ramps for a small amount of cars, the space under the lobby will not be used for parking until Step 4. It will be temporarily used for storage, etc.



SECTION THRU ENTRY



OUTPATIENT ENTRY SYSTEM



VIEW FROM THE WEST

2.2 THE OUTPATIENT BUILDING

The Outpatient Building will,in its new configuration,contain the same functions as were originally programmed for the outpatient and doctors' offices entities, i.e.:

Administration
Health Education
Child Day Care Center
Employee Health Services
State VD Program
Nurses' Services
Clinics:

Clinic A	- Multiphasic Screening
Clinic B-R	- Standard
Clinic S	- Special Dental
Clinic T	- Special Surgery
Clinic U	- Special Surgery
Clinic V	- Special Dietetics
Clinic W	- Special Orthopedic

Doctors' Offices

These entities contain 229,040 gross square feet. It is proposed that 182,240 gross square feet of these functions be contained in this building. The remaining 36,800 gross square feet will be built in Steps 4 and 5 on the lower floors of the High-Rise. These areas will contain the specialty clinics that have a strong relationship with inpatient areas and that desire to be located adjacent to bed areas.

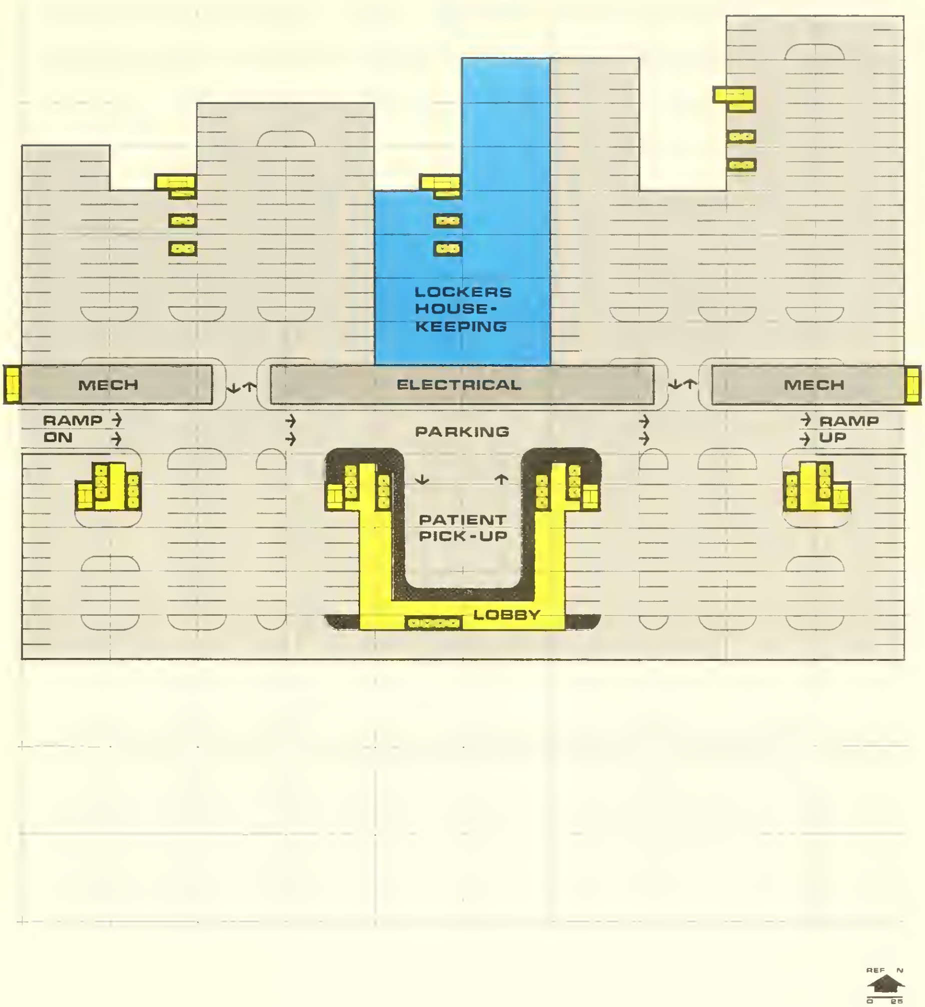
The first level of the Outpatient Building will contain entry and arrival points, main lobby, admitting clinic, and a portion of triage. Patients and public will use escalators and elevators from these points to reach the clinics. Levels 2,3, and 4 located above and extending across Massachusetts Avenue should principally contain such special clinics as ENT and ophthalmology, which require special rooms with complicated or unusual equipment, and clinics with heavy traffic links with Core Services and doctors' offices. The multi-phasic clinics should be located in the same area on the 2nd level,

as they represent the first diagnostic step for admission to outpatient services. Generally, doctors' offices and public waiting areas should occupy the perimeter space, while clinics, their examination rooms, and work spaces should be located in the interior.

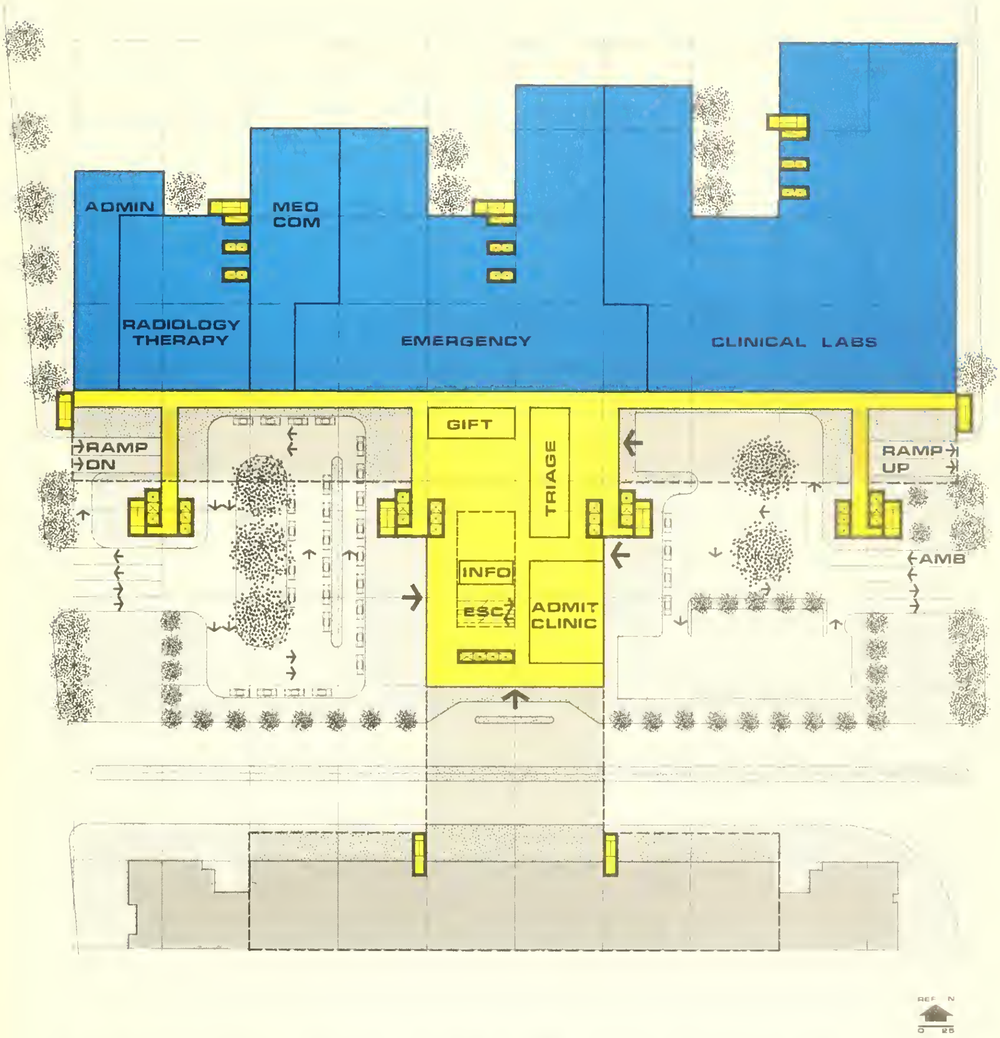
The three levels over the South Block plaza should contain such entities as Health Education with its role of providing continuing education programs for health care personnel, Employee Health Services which provides examination facilities for employees of various departments of the City of Boston (police, fire department personnel, etc.) and nurses services. The nurses service consists of head-quarters for visiting nurse association and provides the conference rooms, record space and offices necessary for these nursing personnel programs.

A desirable use for the top level of the Outpatient Building which is constructed on air rights across Massachusetts Avenue and has expansive vistas up and down the Avenue would be staff and public dining facilities and the Child Day Care Center which could be provided with generous roof deck play areas.

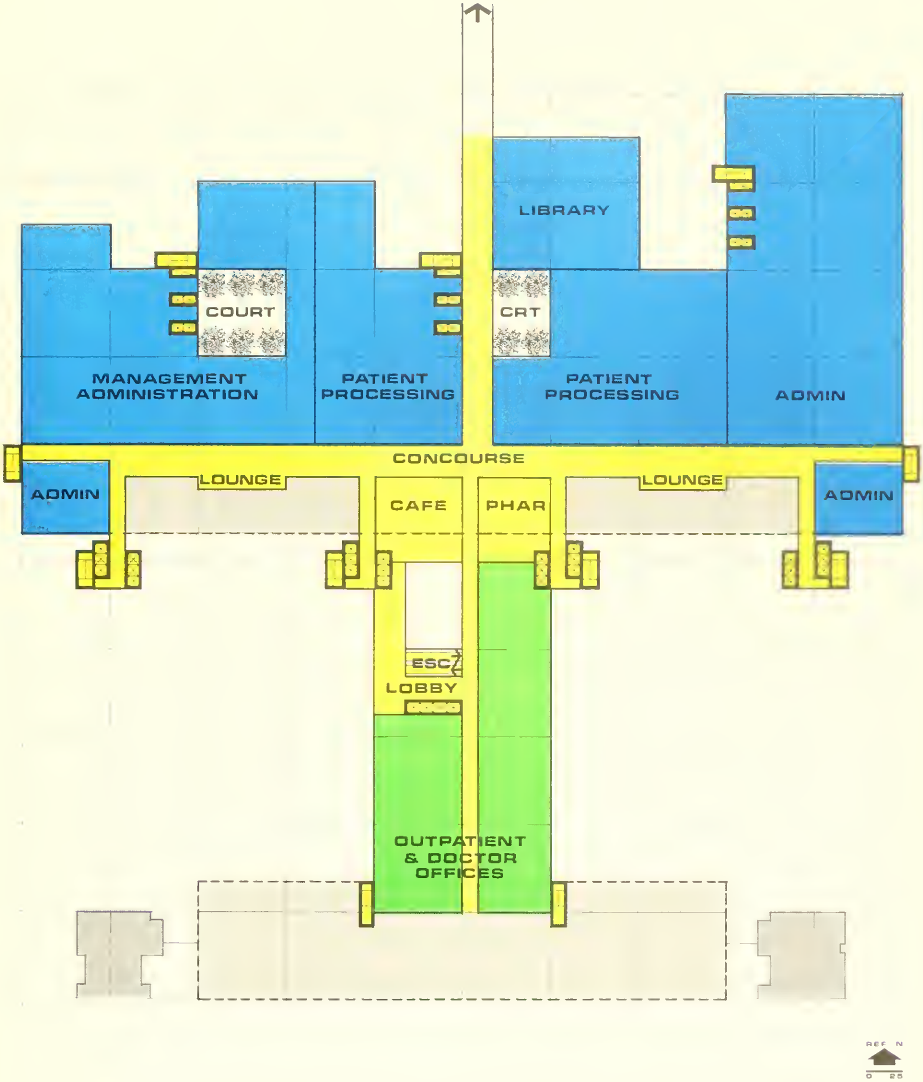
As in the previous design, the configuration of the Outpatient Building, in the form of a "T" extending from the Hospital, will allow its functions to remain open for appointments during evening hours, independently of other departments, should the administration so desire.



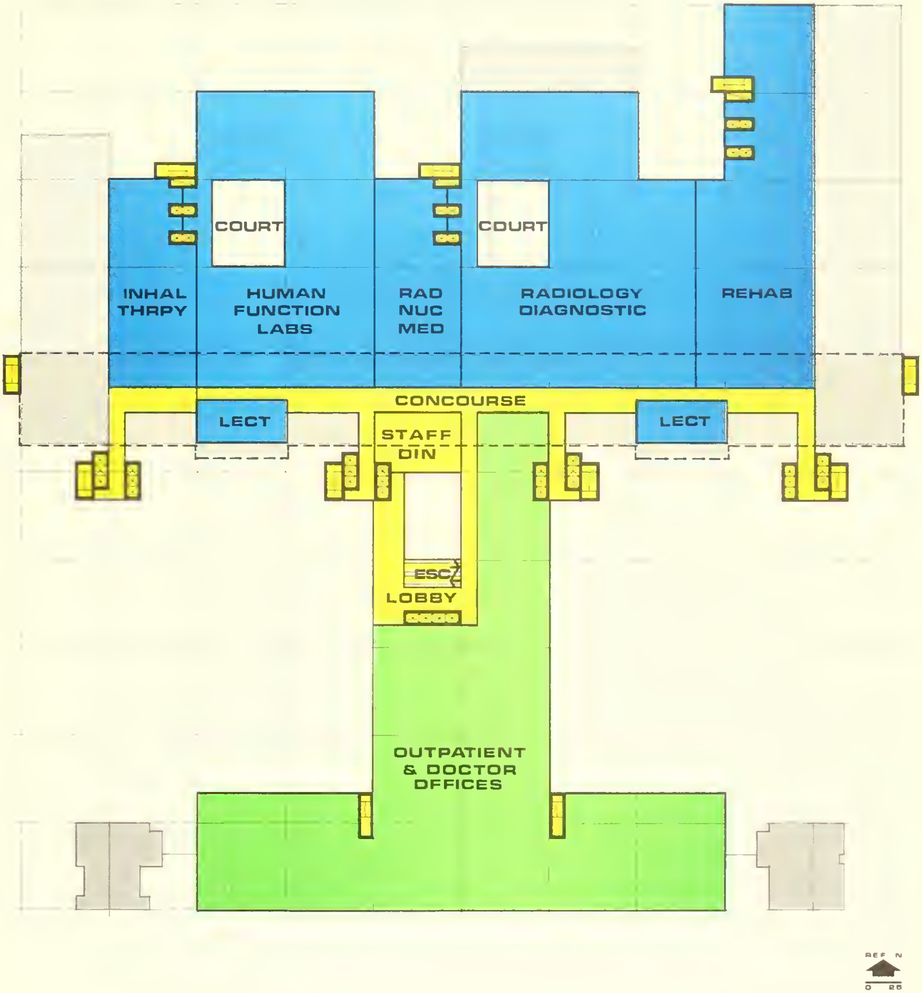
MAIN BLOCK LEVEL B



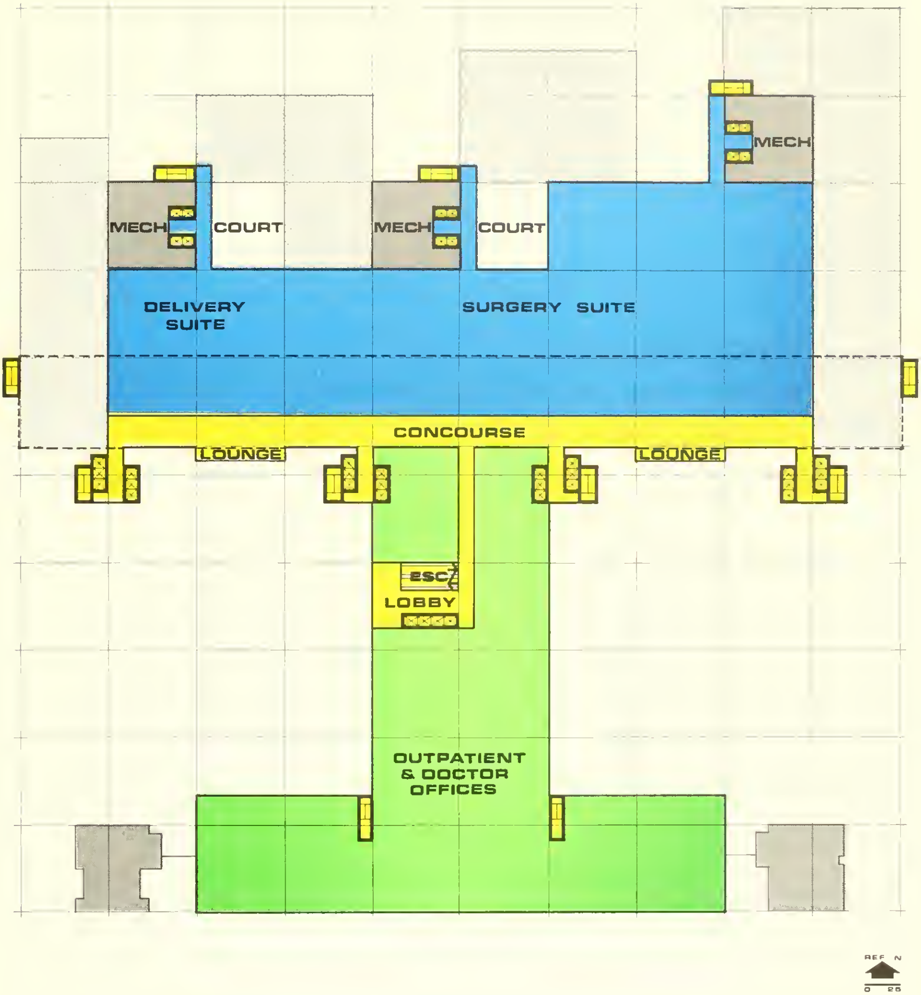
MAIN BLOCK LEVEL 1



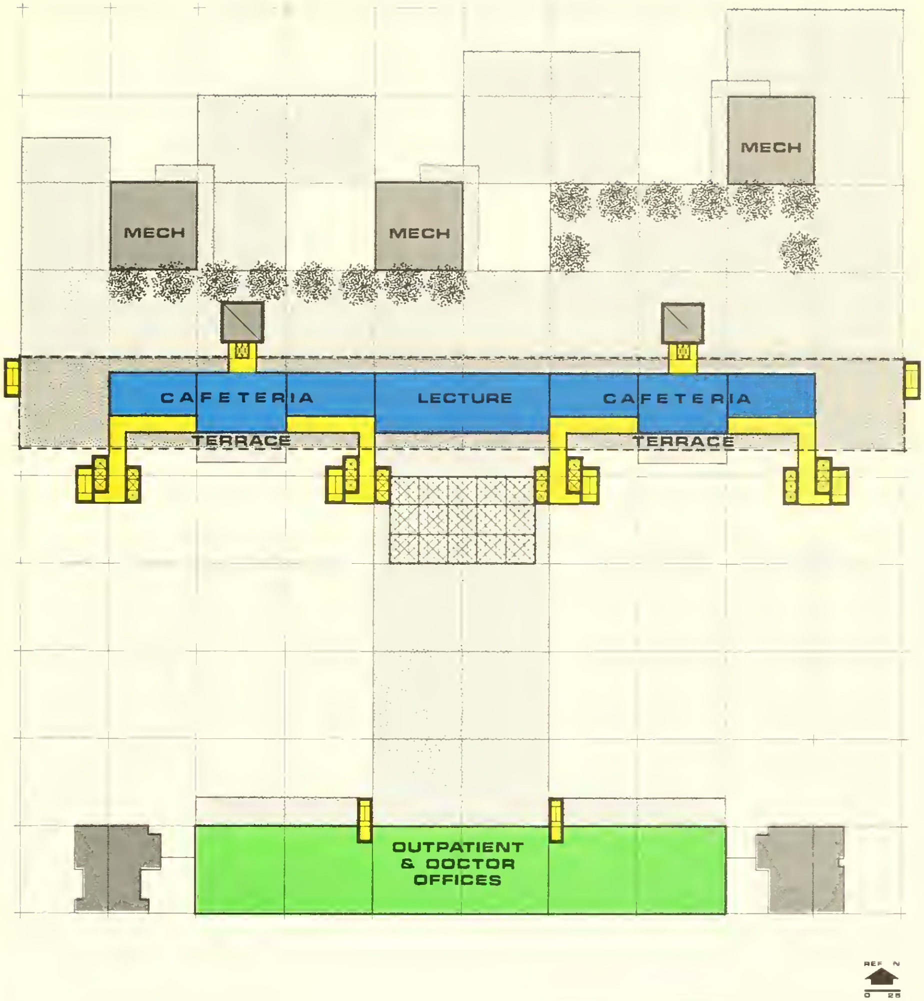
MAIN BLOCK LEVEL 2



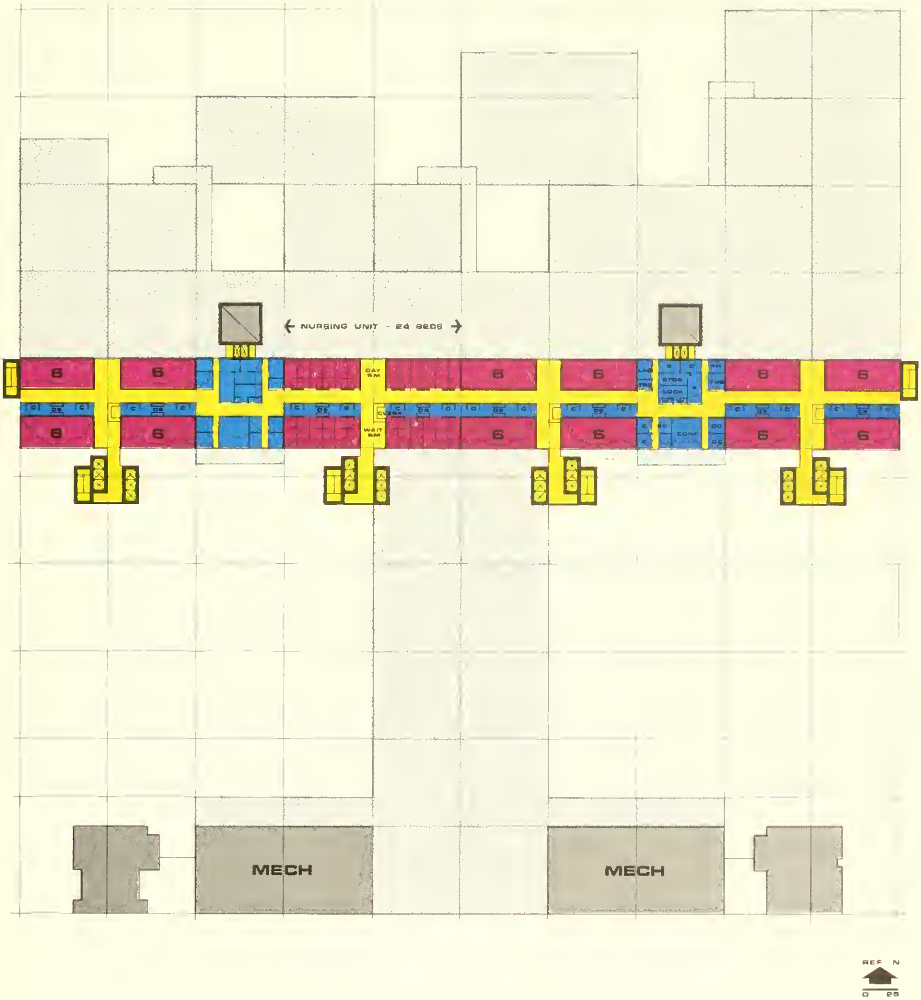
MAIN BLOCK LEVEL 3



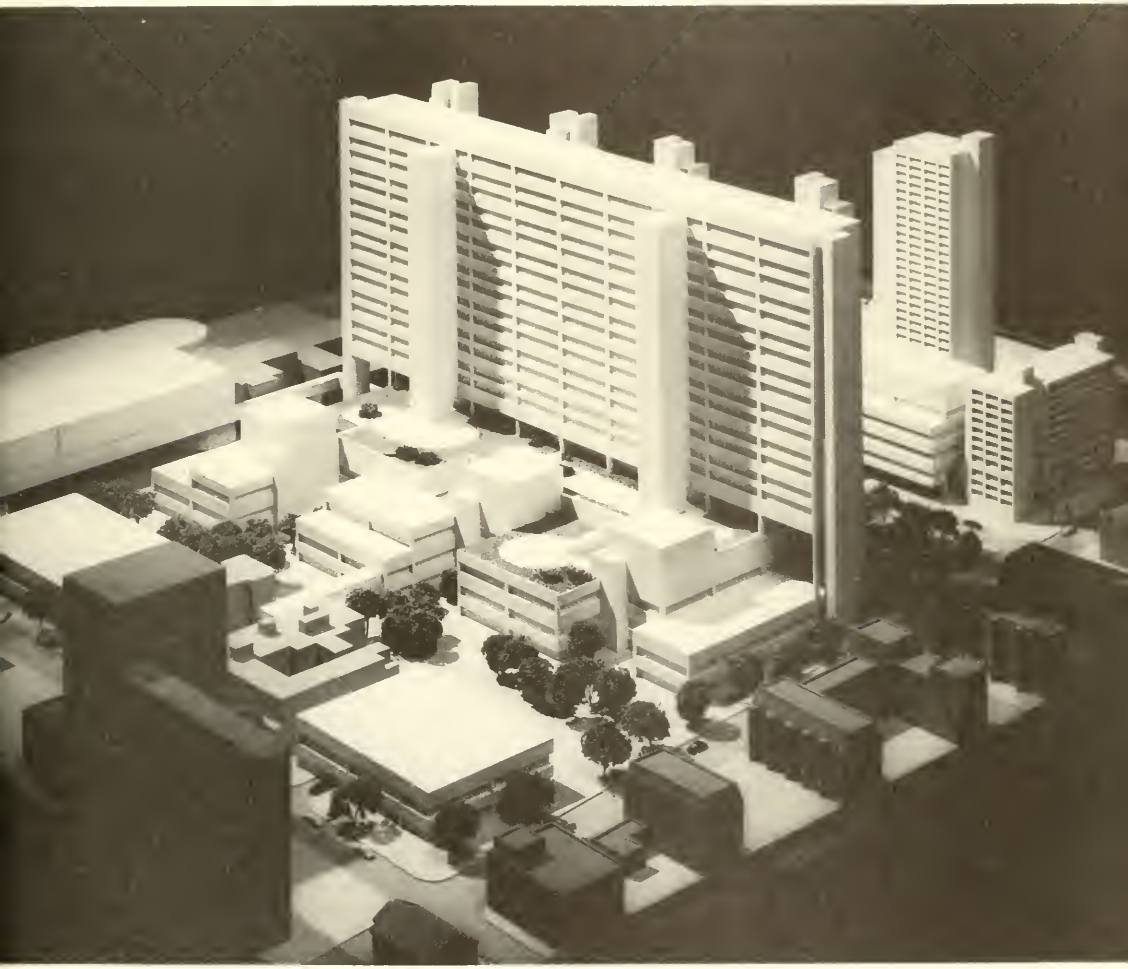
MAIN BLOCK LEVEL 4



MAIN BLOCK LEVEL 5



MAIN BLOCK LEVELS 6-20



VIEW FROM THE NORTH

2.3 STRUCTURAL SYSTEM

The structural system proposed for the Outpatient Building consists of a structural steel frame and precast, prestressed, concrete plank. The fireproofing requirements for the frame will be met by using a combination of plaster or metal lath, concrete and masonry fireproofing. The basic structural element is an 8'-8" deep long-span steel truss. The basic structural bay reflects the planning module and is a 60-foot square. Secondary trusses are located at 20 feet on center, creating 20 feet by 60 feet secondary bays to receive the precast floor planks which span in the 20 feet direction. Supplementary columns will be introduced in the lower garage areas to produce 30 feet by 60 feet structural bays.

This system was chosen because it makes most efficient use of the depth of the required mechanical space for moment resisting efficiency while providing as much free area as possible through the web for supply systems, mechanical, electrical equipment, and personnel.

Trusses, columns, and girders will be fabricated in a remote fabricating plant, as will the prestressed concrete plank. No large area of the site will be required for framework fabrication. Elimination of this space-consuming work is of particular importance in Step 1, during construction of the Outpatient Building, since it allows the retention of Vose House for the longest possible time.

Bridging of Massachusetts Avenue will be accomplished in two spans. One line of three columns will run east and west and be located slightly inside the south property line of the Main Block. Another line of three columns will be located in the center of the median strip of the Avenue, while a third row of columns will be located inside the north property line of the South Block. A fourth row of columns supporting the Outpatient Building will be located 60' to the south and will penetrate the parking levels of the South Block garage and be founded on the piles below. These columns will avoid the traffic aisles and be positioned in the parking stall area.

Foundation support for this structure will be received

from pipe piles driven through the clay to the underlying bedrock. If the glacial till is of sufficient load capacity, concrete piers socketed deep into the rock at column points could result in savings of approximately $6,000 per column foundation unit, as compared to other foundation methods.

The subsurface investigation of soils conditions that will result from the boring program proposal presently before the PFD for approval must be carried out in order to make a decision on the foundation design.

2.4 MECHANICAL AND ELECTRICAL SYSTEMS

The underlying design philosophy for the mechanical and electrical systems was a response to the demands for flexibility in a medical center such as BCH. It proposes the maximum utilization of building space for hospital purposes by having all systems emanate from a central point and be distributed as pipelines or ducts throughout the complex. By using separate systems floors the least amount of valuable space on use levels is consumed by the utilities, and supply of every service can be made available to every area. Risers are located outside the main use areas. The central equipment serving the risers is sized only to meet the requirements of the diversified demands of the building as a whole. Serving all systems from a central equipment area permits the use of heavy-duty reliable machines in a few locations instead of numerous light-duty, less reliable machines in many locations.

The large number of mechanical, electrical, and communications systems serving the clinics and the variety of uses to which the spaces will be put, such as offices, laboratories, minor operating suites, X-ray, classrooms, etc. suggests the need for this design in the Outpatient Building. In the June, 1969 Master Plan a systems floor was provided over each use level in the Outpatient Building and Core Services.

Because of the extent of services required all mechanical and electrical services for the revised Outpatient Building should be fed from the power plant on the East Block. Pipe runs should cross Massachusetts Avenue in the large truss between the 2nd and 3rd levels and be distributed vertically to each bay on the South Block.

Airhandling units will be located on the roof of the structure. The airconditioning system will generally be 100% fresh air because of the many diverse requirements that will exist. In perimeter spaces the

air will be supplemented with radiation under windows and along exterior walls to combat downdrafts in cold weather. Thermostatic control will be provided in each space.

The electrical distribution will be similar to the mechanical distribution system in that power will originate from a single metering for the entire complex, in the mechanical plant on the East Block. Four substations will receive the power on the Main Block; one of which will be located in the basement of the Outpatient Building.

Presently, the housing units and nurses school to be constructed in the South Block are designed to have separate metering systems. Since there would be an economy in combining the metering, the design of the complex should permit future change-over to a single metering system, in the event the Hospital would find this preferable in the future.

2.5 VERTICAL TRANSPORTATION

Since the entry and main lobby plan are essentially similar it is reasonable to apply the same criterion for the design of the vertical transportation system:

1. A waiting time not to exceed 45 seconds for all conditions, whether the car is used exclusively for passengers or a combination of passengers and equipment.
2. The round-trip time (from level 1 to level 20) should not exceed 240 seconds.
3. The elevator lobbies on the inpatient floors should be near the center of activity in each nursing unit for control of visitors and ease of moving patients to core services.

The vertical transportation system for the Outpatient Building should consist of one bank of four passenger elevators, serving all floors located in the main lobby near Massachusetts Avenue. They will have a 4000-pound-capacity and travel at a speed of 350 feet per minute. In addition, escalators should supplement the elevator service and run from the entrance level to the third level.

The new entry pattern will require additional elevators and a lobby in the portion of the Outpatient Building contained on the South Block. This elevator bank should contain passenger cars. However, their relationship to the entries along Massachusetts Avenue and traffic volumes are dependant upon the type of clinics they serve. A detailed study should be undertaken in the next design steps to determine the actual requirements.

Another aspect of the vertical transportation system that will have to be re-studied for later steps is the change in loading on the four main elevators towers serving the High-Rise. The altered internal traffic pattern, caused by the re-design of the Outpatient Building, makes it likely that the two central towers should contain a larger number of cars than the outer towers.

2.6 MATERIALS HANDLING SYSTEM

The Outpatient Building is a significant user of supplies. The movement of these supplies account for approximately 20% of the supply volumes of the total Hospital. The logistics study, entitled "Supplementary Report - Materials Handling Systems" prepared by Souder, Clark and Associates and by the Partnership illustrates that of 3340 daily supply trips throughout the Hospital, 615* are required by the outpatient and doctors' offices entities. The recommended materials handling system, "Cyberail", works well with the long span, deep truss structural system, since the guideway for the Cyberail system can run in the systems floors and rise or drop into the use levels only at terminal points, thereby avoiding constraints on the planning, use, and flexibility of any spaces other than terminal spaces.

> "Supply systems, which must relate to specific activities within departments, can become severe constraints on departmental design; therefore, a supply system using a minimal number of vertical risers through systems floor space to points directly above or directly below the optimal positions in the departments it serves offers unusual flexibility. In concept such a system can provide downfeed or upfeed to local terminals wherever they are needed"**

A loop of the basic distribution system should extend through the Outpatient Building in the large systems floor between the 2nd and 3rd levels, go vertically in a riser and branch out east, west in the trusses at each level and finally upwards to the use points. A careful study of this loop and its terminals must be made to coordinate it with the mechanical/electrical systems in order not to limit the flexibility of these systems.

* See diagram 2 of Supplementary Report - Materials Handling Systems

** Supplementary Report - Materials Handling Systems, Implications for physical design, page 28.

3.0 REVISED PLANNING IMPLEMENTATION

Starting with a revised cost estimate for the total construction, this section outlines the new plan for demolition and reconstruction of BCH in a series of steps reflecting the revisions proposed to the Outpatient Building.

3.1 REVISED CONSTRUCTION PHASING AND CONSTRUCTION COST ESTIMATE

The supplementary construction cost analysis is based on the scope of work as presently envisioned and on the sequence of construction phasing as indicated in the construction schedule network diagram (diagram R43).

The major changes to the schedule have occurred in steps 1, 2 and 3. Steps 4, 5 and 6 are essentially as presented in the Master Plan. Construction is still planned in six major steps, commencing with the construction of the Outpatient Building in June 1970, and ending with completion of the Hospital in June 1975, of the parking structures north of the Hospital in June 1976, and with the landscaping in July 1976.

The new construction cost analysis indicates a funding requirement of approximately $140,088,800, including Group I and II equipment and material handling systems. This amount was determined by evaluating the construction costs as of February 1969, ($103,520,100), and escalating each construction step to the midpoint of its construction duration. The total escalated project cost, including design and fine art fees, nonfixed equipment and fees, furnishings, clerk of works, and contingencies, amounts to $171,518,400. The distribution of these amounts is shown for each step in the following tables:

Revised Summary of Construction Costs

Step	February 1969 Costs	Escal. Index	Escalated Bid Costs
1	$ 11,400,500	122.5	$ 13,965,600
2	5,216,000	122.1	6,368,700
3	10,409,700	132.1	13,751,200
4	34,847,300	130.7	45,545,400
5	39,976,200	144.8	57,885,500
6	1,670,400	154.0	2,572,400
	$ 103,520,100		$140,088,800

Revised Summary of Escalated Project Costs

Step 1	$ 17,207,200
Step 2	7,415,700
Step 3	16,739,200
Step 4	55,985,600
Step 5	71,238,200
Step 6	2,932,500
	$ 171,518,400

The above figures indicate a decrease in the total escalated project cost of 1.8 million dollars. This is due to construction of a greater portion of the Outpatient Building at an earlier time. It is also due to a smaller circulation area in the new Outpatient Building configuration.

Revised Escalated Project Costs

Project cost is defined as total cost of the project including fees, furniture, nonfixed equipment, equipment fees, and contingencies, but not including land costs or legal fees. The escalated project cost is determined by applying a factor to the escalated bid cost for each step. The factors below are the same as in the Master Plan. They are included below for clarification of the project costs.

Other Costs as Percent of Costs	General Construction	Utilities, Parking, etc.
Architects/Engineers fees	.065	.08
Equipment	.11	--
Equipment fee	.004	--
Fine art and fee	.005	--
Clerk of works	.01	.01
Contingency	.05	.05
Factors subtotal	.244	.14
Construction cost factors	1.000	1.00
Escalated project cost factors	1.244	1.14

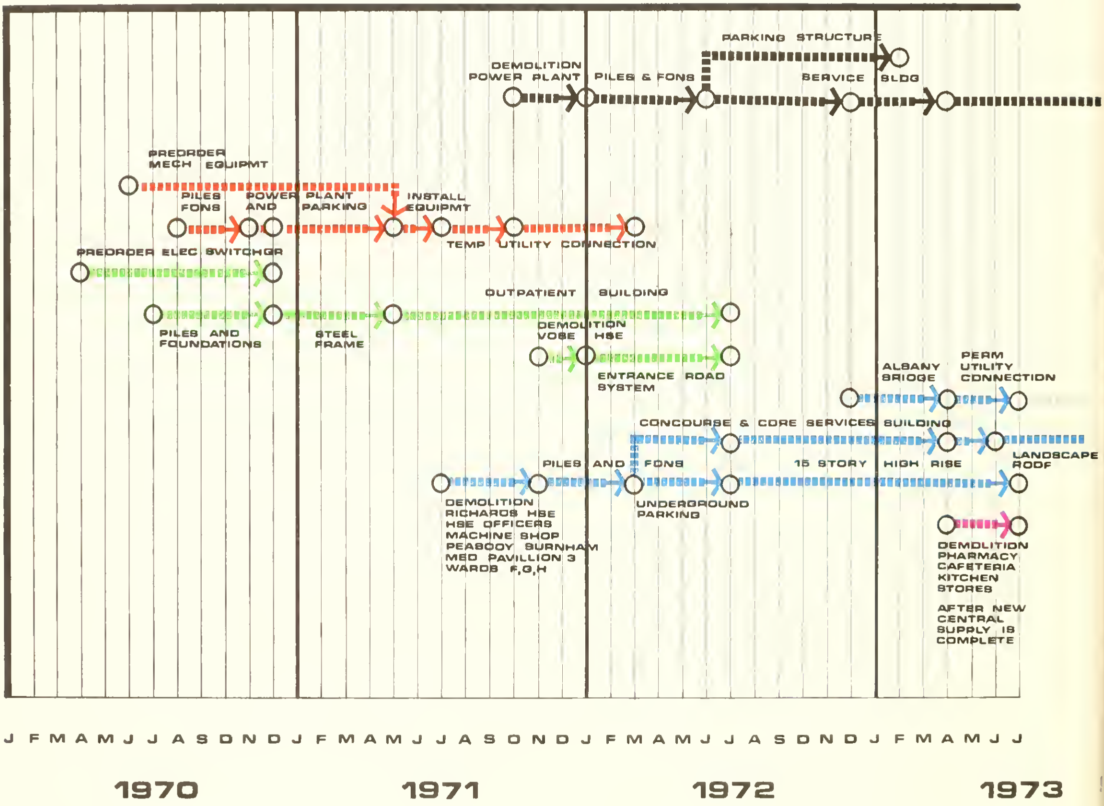
Escalation Index

The basis of the escalation index used for each construction step is the same as determined in the economic report for the City of Boston from 1968 to 1978 (see section 6.3 of the Master Plan). These escalation indexes, from February 1969 (100.0) to the midpoint of the construction steps, are as follows:

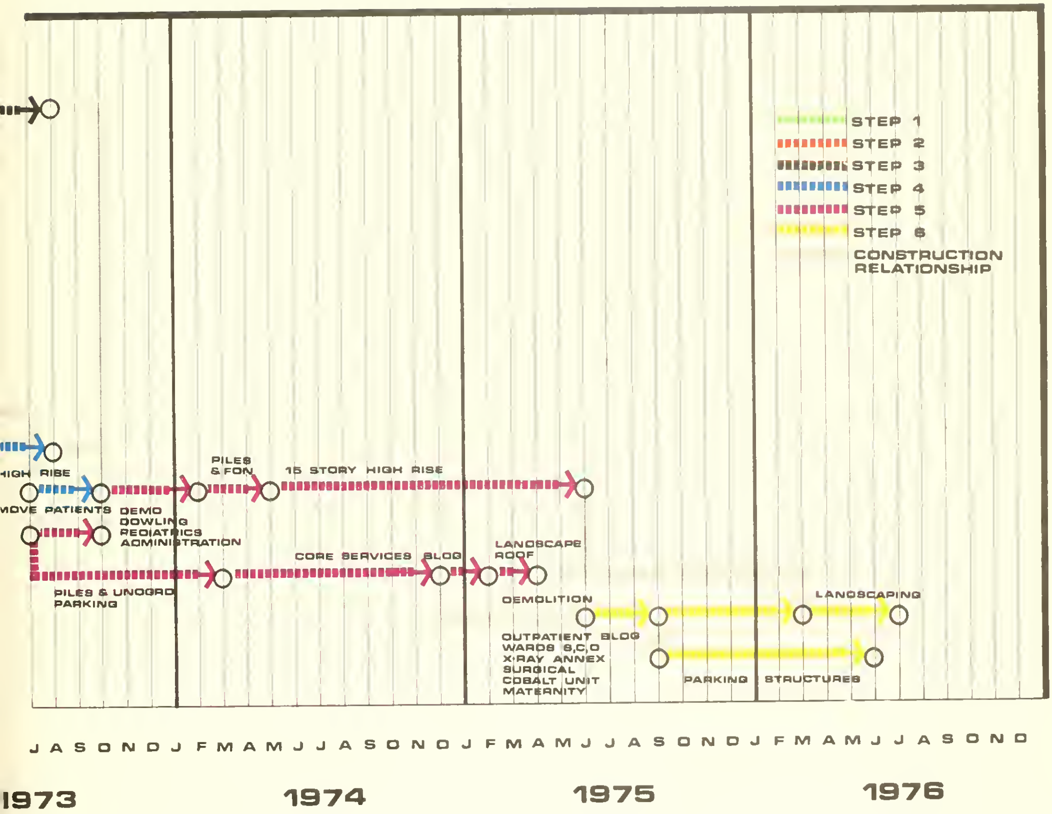
Step	Start Demolition/ Construction	Midpoint Construction	Escal. Index
1	July 1970	June 1971	122.5
2	July 1970	May 1971	122.1
3	Oct. 1971	Sept. 1972	132.1
4	July 1971	August 1972	130.7
5	April 1973	May 1974	144.8
6	June 1975	Nov. 1975	154.0

These escalation indexes increase the requirements for construction funding by an average of 35% over the current estimated costs for 1969.

The text which follows is a summary of descriptions, a summary of procedures, and a summary of costs for each of the six steps of construction for the project. Diagrams illustrating portions of buildings and level-by-level plans, as well as a table showing areas of each major entity to be constructed in each step are included. Diagram R43 illustrates the presently envisioned sequence of work.



CONSTRUCTION



PHASING SCHEDULE

DESCRIPTION	ELEMENT (NSF) HS/RA	ELEMENT (GSF) HS/RA	CONSTRUCTION PHASING BY ELEMENT (GROSS SQUARE FEET)					
			1	2	3	4	5	8
ENTITY TOTAL - ADMINISTRATIVE SERVICES	49,520	68,100	—	—		19,760	48,340	—
Administration	31,010	43,000	—	—	—	6,640	36,360	
Management	18,510	25,100	—	—	—	13,120	11,980	—
ENTITY TOTAL - CORE SERVICES	179,100[1]	246,120	—		20,550	67,950	157,620	—
Central sterile supply	10,970	13,070	—	—	13,070[1]	—	—	—
Clinical laboratories	33,480	46,160	—	—	—	1,840	44,320	—
Delivery suite	8,270	13,130	—	—	—	6,130	7,000	
Human functions laboratory	14,225	21,450	—	—	—	—	21,450	—
Inhalation therapy	4,990	7,360	—	—	—	7,360		
Lecture rooms	6,900	8,960	—	—	—	4,480	4,480	
Medical Communications	7,320	9,830	—	—	—	—	9,830	
Medical library	6,190[1]	9,230	—	—	—	—	9,230	
Pharmacy	8,130	9,760	—	—	7,480	2,280	—	—
Radiology - diagnostic	18,490	23,91	—	—	—	9,190	14,720	—
Radiology - nuclear	5,590	7,360	—	—	—	7,360	—	
Radiology - therapy	6,730	9,830	—	—	—	9,830	—	—
Rehabilitation	12,105	17,570			—	—	17,570	—
Surgery suite	35,710	48,50			—	19,480	29,020	—
ENTITY TOTAL - DOCTORS' OFFICES	48,240	67,780	67,780	—	—	—	—	—
ENTITY TOTAL - DIETARY	40,510	56,890	—	—	36,420	13,150	7,320	—
Administration	3,940	4,730	—	—	4,730		—	—
Food supply	5,680	6,820	—	—	6,820	—	—	
Kitchen	12,300	24,870	—	—	24,870		—	—
Dining	18,590	20,470	—	—	—	13,150	7,320	—
ENTITY TOTAL - EMERGENCY SERVICES	24,670	34,950	—	—	—	17,380	17,570	—
Entrance	3,070	4,700	—	—	—	2,350	2,350	
Support facilities	2,490	3,500	—	—	—	1,750	1,750	—
Treatment facilities	12,550	17,570	—	—	—	8,770	8,800	—
Diagnostic/holding	5,030	7,030		—	—	3,160	3,870	—
Personnel area	960	1,350	—	—	—	1,350	—	—
Cardiac resuscitation	570	800	—	—	—	—	800	—
ENTITY TOTAL - INPATIENT SERVICES	390,450[2]	515,200[2]	—	—	—	257,600	257,600	—
Intensive care	19,620	27,600	—	—		27,600	—	
Acute care	243,460	322,000		—		211,600	110,400	
Extended care	27,720	36,800		—	—	—	36,800	
Chronic care	83,170[2]	110,400[2]	—		—	—	110,400	
Other inpatient services	16,480	18,400	—	—		18,400		
ENTITY TOTAL - LAUNDRY	22,660	24,740	—	—	24,740	—	—	—
ENTITY TOTAL - OUTPATIENT SERVICES	83,120	114,460	77,660	—	—	18,400	18,400	—
Administration	2,330	3,260	3,260	—	—	—	—	
Health education	1,140	1,590	1,590	—	—	—	—	—
Child day care center	6,670	9,300	9,300	—		—		—
Employee health service	2,820	3,900	3,900	—	—	—	—	—
State vd program	780	1,050	1,050	—		—	—	
Nurses services	3,200	4,100	4,100	—	—	—		—
Clinics A through W	66,080	91,260	54,460	—		18,400	18,400	
ENTITY TOTAL - PATIENT PROCESSING	27,060	41,790	3,680	—	—	20,940	17,170	—
Triage	1,990	3,140		—	—	3,140	—	—
Admitting clinic	6,990	7,970	3,680	—		4,290	—	—
Discharge	3,550	4,970		—	—	4,970		—
Medical records	14,530	25,710	—	—		8,540	17,170	
ENTITY TOTAL - PHYSICAL PLANT	24,040	28,840	—	—	28,840	—	—	—
Maintenance of buildings & grounds	17,980	20,840		—	20,840	—	—	—
Safety	1,260	2,000	—	—	2,000	—	—	—
Automotive maintenance	4,800	6,000	—	—	6,000		—	—
ENTITY TOTAL - SUPPLY AND STORAGE	56,870	81,920	—	—	62,620	13,780	5,520	—
Housekeeping	8,970	12,000			—	10,200	1,800	—
Locker rooms	6,080	7,300	—		—	3,580	3,720	—
Storage	41,820	62,620	—		62,620	—		—
SUBTOTAL	940,640	1,280,790	149,120	—	173,170	428,960	529,540	—
Mechanical plant		29,400	—	29,400				—
SUBTOTAL	940,640	1,310,190	149,120	29,400	173,170	428,960	529,540	—
Circulation and mechanical		324,300[3]	52,800	2,400	23,020	144,370	101,710	
SUBTOTAL		1,634,490	201,920	31,800	196,190	573,330	631,250	—
Parking		570,000	10,760	181,910	119,660	62,060	107,290	88,320
TOTAL		2,204,490	212,680	213,710	315,850	635,390	738,540	88,320

[1] Increase from LGAI program
[2] Increase due to 300 chronic care beds
[3] Included in LGAI gross figures

SPACE PROGRAM

3.1.1 REVISED SUMMARY OF STEP 1

Design and construct approximately 212,680 gross square feet of the Outpatient Building to house community-related clinics, doctors' offices, and space for future underground parking.

Level 1 will contain the main entrance (from Massachusetts Avenue and the entrance court from Harrison Street), lobby, and portions of admitting clinic, and appointment and information centers. Levels 2 through 5 will contain doctors' offices and clinics. Level B will contain storage areas (to be converted to parking during a later construction step) a pick-up lobby, electrical equipment rooms, and elevator service to the floors above. Steam for this facility will be from the new 16" main to be provided by Boston Edison Company. Airconditioning and electrical power will be received from the mechanical plant to be constructed in step 2. The existing dietary, central sterile supply, and laundry will provide services on an interim basis.

Vertical transportation on the Main Block will be provided by multipurpose elevators capable of handling passengers, beds, and equipment. Escalators from level 1 to the upper floors will also be provided. Vertical transportation on the South Block should be provided by multipurpose elevators from the parking levels.

The demolition of Vose House is required for the construction of the Outpatient Building. This necessitates the temporary relocation of its present occupants. PFD has decided to move the resident nurses to Franklin Square House, a residence hall, and the school spaces to Boston City College High School.

Revised Summary of Procedure for Step 1

a. Design: start January 1970

b. Demolition of Vose House (2 months): start November 1971

c. Construction (24 months): start July 1970 (includes pile foundation, temporary parking, outpatient clinics, doctors' offices)

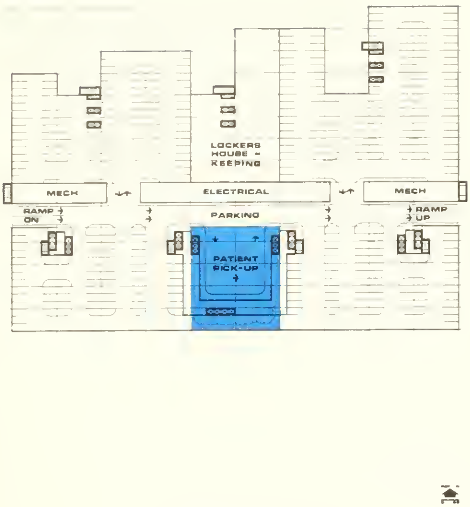
d. Construct entry roads and on-grade parking

e. Relocate primary switchgear

f. Occupancy: July 1972

Revised Summary of Costs for Step 1

		February 1969 Costs	Escal. Index	Escalated Bid Costs
a.	Demolish Vose House	$ 136,400		
b.	Construct piles, foundations and storage areas in Level B (10,760)	396,800		
c.	Construct doctors' offices (67,780)	3,050,100		
d.	Construct outpatient services (77,660)	3,455,900		
e.	Construct patient processing (3,680)	152,700		
f.	Construct circulation areas, mechanical spaces (38,080)	1,193,800		
g.	Mechanical equipment rooms (14,720)	994,400		
h.	Additional roof work	110,400		
i.	Equipment and casework	500,000		
j.	Vertical transportation	640,000		
k.	New sanitary and storm sewers, water and gas	350,000		
l.	New electrical equipment	230,000		
m.	Temporary work	190,000		
	Total Step 1	$11,400,500	122.5	$13,965,600
	Escalated project cost Step 1			17,207,200



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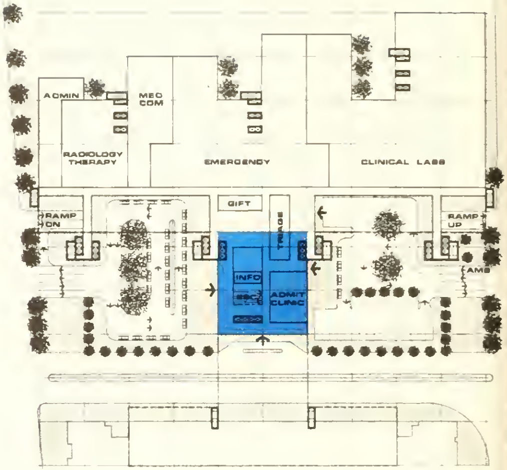

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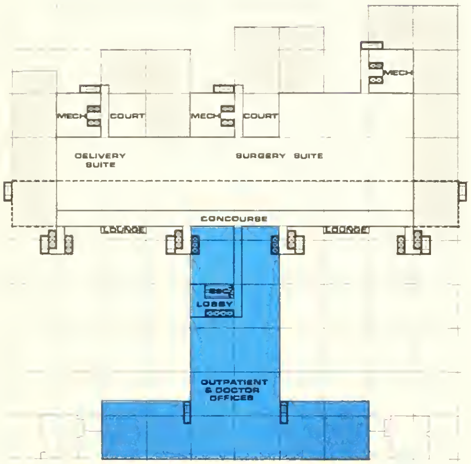

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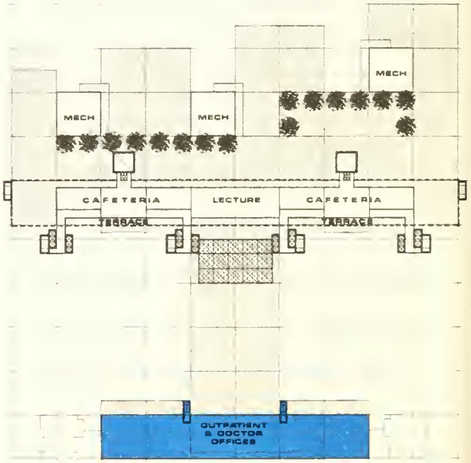
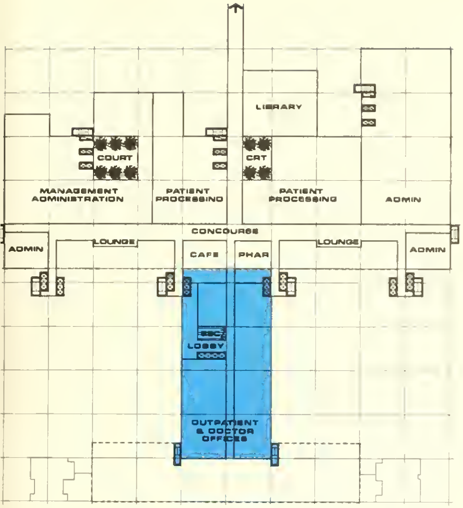


LEVEL 5

STEP 1



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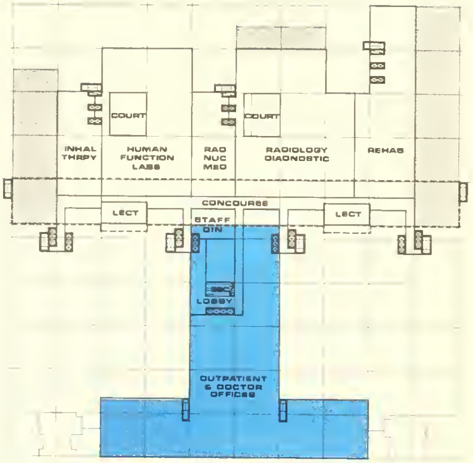

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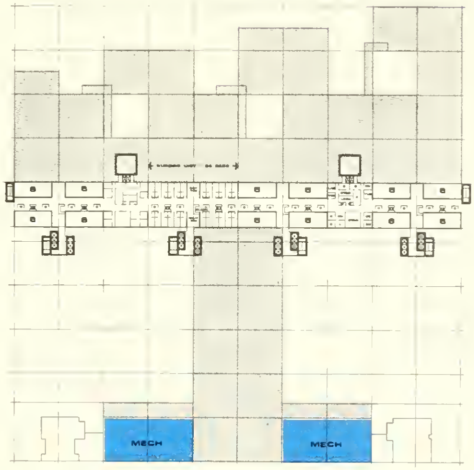


LEVELS 6-20

MAIN BLOCK

3.1.2 REVISED SUMMARY OF STEP 2

Design and construct approximately 213,710 gross square feet of the East Block's Service Building which will contain the mechanical plant, and a parking garage.

The mechanical plant will initially be equipped with mechanical, electrical, and telephone equipment for the existing facilities and those constructed in step 1. Additional cooling capacity will be installed during steps 4 and 5.

The six-story parking structure for 480 cars will be built along the east property line adjacent to the Service Building. Access to the garage will be from East Concord Street and Albany Street. Primary users of the facility will be staff and employees.

Vertical transportation from the parking structure to grade will be provided by two passenger elevators serving all floors.

In order to meet the construction schedule, there are two owner responsibilities that must be performed prior to the commencement of construction activities:

1. Relocation of the Department of Water's building and storage yard to a new location off-site. Negotiations have been undertaken between the PFD and the Department of Water, and it appears that this can be accomplished on schedule.

2. Preorder required mechanical and refrigerant equipment. Preordering is necessitated by a required lead time of at least twelve months for fabrication and delivery of this equipment. It is necessary that this equipment be installed prior to the completion of step 1 and the demolition of the existing power plant. Temporary connections of utility lines from the new mechanical plant can then be made to the existing distribution system.

Revised Summary of Procedure for Step 2

a. Design: start January 1970

b. Preorder mechanical and refrigeration equipment: June 1970

c. Relocate machine shop: complete November 1970

d. Demolition (2 months): start November 1970

e. Construct new mechanical plant, install portion of mechanical and refrigerant equipment (10 months): start July 1970

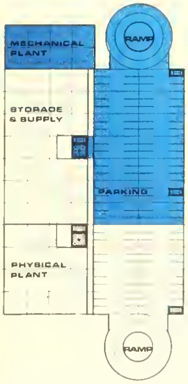
f. Construct approximately half of the parking structure

g. Disconnect existing utility and power lines from existing power plant and connect to new plant

h. Occupancy: October 1971

Revised Summary of Costs for Step 2

		February 1969 Costs	Escal. Index	Escalated Bid Costs
a.	Demolish City machine	$ 76,800		
b.	Construct new mechanical plant (29,440 SF)	2,528,700		
c.	Construct piles, foundations and parking (181,910 SF)	1,990,300		
d.	Construct circulation areas (2,400 SF)	75,200		
e.	Vertical transportation	120,000		
f.	Connect utility lines	410,000		
g.	Temporary work	15,000		
Total Step 2		$5,216,000	122.1	$6,368,700
Escalated project cost Step 2				7,415,700



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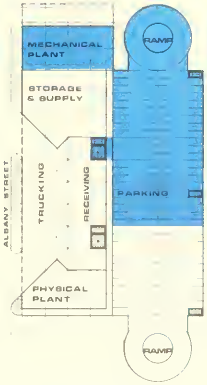

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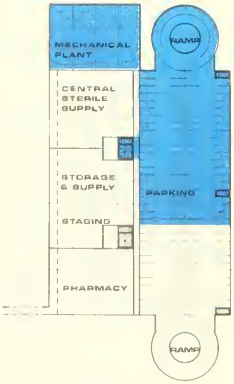

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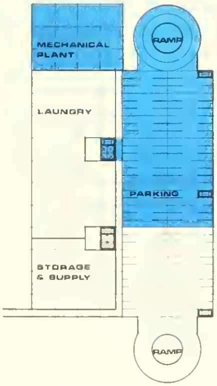

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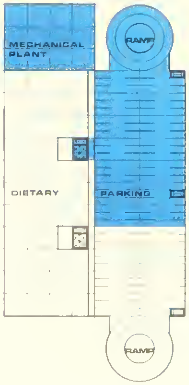


LEVEL 4

STEP 2 EAST BLOCK

3.1.3 REVISED SUMMARY OF STEP 3

Design and construct approximately 315,850 gross square feet of the East Block's Service Building. This step will be the complete programmed area for the East Block and unite the East Block with the Main Block by means of a bridge across Albany street.

Construction of these new services, coincident with the completion of step 4, makes it mandatory that the bridge across Albany Street be constructed during this step. Permanent utility connections must also be made to the facilities on the Main Block constructed during steps 1 and 4.

Level B will contain physical plant and storage spaces. Level 1 will contain receiving dock and additional physical plant and storage spaces. Level 2 will contain pharmacy, central sterile supply, and the staging area for the materials handling system's carts. Level 3 will contain laundry and storage, and level 4 the dietary service.

Completion of this structure will add 280 parking spaces.

Vertical transportation installed in this step will include two additional passenger elevators and four large freight elevators, two of which will be installed in shafts constructed during step 2.

Revised Summary of Procedure for Step 3

a. Design: start January 1970

b. Demolition of boiler plant and maintenance shop (3 months): start October 1971

c. Construction (15 months): start January 1972

d. Construct new service access roads from Albany Street

e. Construct material handling, utility, and personnel bridge over Albany Street

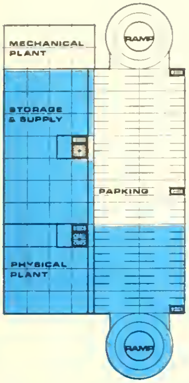
f. Remove temporary utility and power connections and make permanent connections

g. Relocation of laundry equipment and demolition of laundry building (4 months): start April 1973

h. Occupancy: April 1973

Revised Summary of Costs for Step 3

		February 1969 Costs	Escal. Index	Escalated Bid Costs
a.	Demolish power plant, smoke stacks, maintenance shops	$ 280,600		
b.	Construct piles, foundations and parking (119,660 SF)	1,580,800		
c.	Construct core services (20,550 SF)	868,700		
d.	Construct dietary (36,420 SF)	1,856,800		
e.	Construct laundry (24,740 SF)	1,450,400		
f.	Construct physical plant (28,840 SF)	828,700		
g.	Construct supply and services (62,260 SF)	1,980,000		
h.	Construct circulation (23,020 SF)	721,700		
i.	Vertical transportation	300,000		
j.	New sanitary and storm sewers, water and gas	30,000		
k.	Site work	12,000		
l.	Albany Street bridge	200,000		
m.	Permanent utility connections	300,000		
Total Step 3		$10,409,700	132.1	$13,751,200
Escalated project cost Step 3				16,739,200



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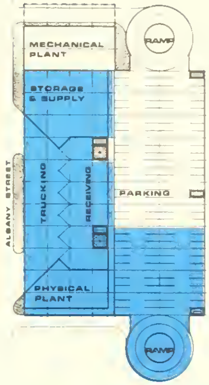

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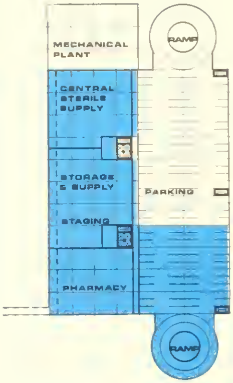

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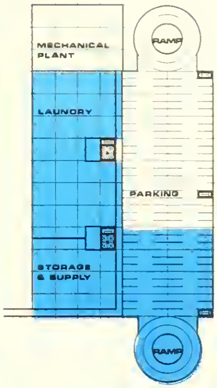

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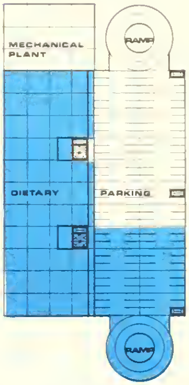


LEVEL 4

STEP 3 EAST BLOCK

3.1.4 REVISED SUMMARY OF STEP 4

Design and construct 15-story High-Rise tower containing approximately 672 beds and portions of core services, administrative services, emergency services, patient processing, supply and services, outpatient clinics, and underground parking.

The completion of this step will provide a viable Hospital with portions of all the required entities and systems. Should it be desired, Medical Building and Curley Pediatrics Building could be integrated into the system on an interim or permanent basis. However, if the construction sequence proceeds as indicated in the construction phasing diagram, patients and services from these two buildings, as well as Dowling Building, will be moved into the new facility and these buildings will be demolished as a part of step 5.

Level B will contain parking, lockers, housekeeping facilities, electrical substations, and emergency generators. Level 1 will contain entrance court, triage, portions of admitting clinic, emergency, radiation therapy, medical communications, and portions of clinical laboratories. Level 2 will contain portions of patient processing, administration, and dispensing pharmacy. Level 3 will contain portions of diagnostic radiology, nuclear radiology, inhalation therapy, dining rooms, and a lecture hall. Level 4 will contain portions of the surgery and delivery suites. Level 5 will contain cafeteria, dining rooms, and a lecture room. Level 6 will contain additional outpatient clinics. Levels 7 through 20 of the High-Rise will contain inpatient services.

The existing emergency department and ambulance entrance, located at the northeast corner of Dowling, will be maintained during construction and move to the new quarters at the completion of step 4.

The redesign of the South Block and the subsequent delay of construction will no longer permit relocation of the functions contained in Richards House and House Officers Building to the South Block. These functions and the inpatient facilities in Peabody Burnham will have to be temporarily accomodated in existing buildings on the Main Block.

Additional mechanical and refrigeration equipment will be installed in the power plant in the East Block during this step.

Revised Summary of Procedure for Step 4

a. Design: start January 1970

b. Demolition of machine shop and Medical Pavilion III: start July 1971

c. Relocation of occupants of Richards House and House Officers Building: June 1971

d. Demolition of Richards House and House Officers Building (2 months): start July 1971

e. Relocate functions of Peabody Burnham and Wards FGH: October 1971

f. Construction (23 months): start November 1971

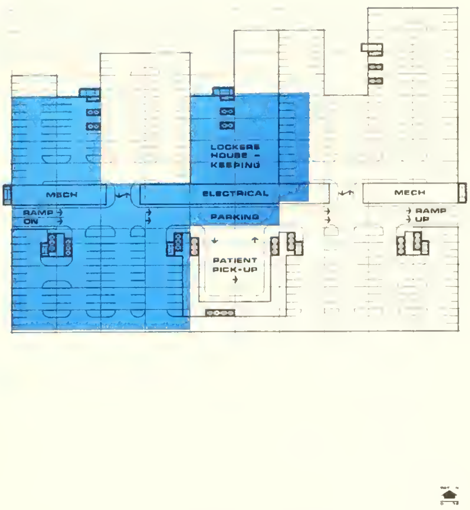
g. Occupancy: October 1973

Revised Summary of Costs for Step 4

		February 1969 Costs	Escal. Index	Escalated Bid Costs
a.	Demolish Richards House, House Officers Building, Machine Shop, Peabody Burnham Building, Wards FGH Building, Medical Pavilion III	$ 256,400		
b.	Piles and foundations	600,000		
c.	Underground Parking (62,060 SF)	558,500		
d.	Construct administrative services (19,760 SF)	820,000		
e.	Construct core services (67,950 SF)	3,652,400		
f.	Construct dietary (13,150 SF)	598,300		
g.	Construct emergency services (17,380 SF)	968,900		
h.	Construct inpatient services (257,600 SF)	13,459,600		
i.	Construct outpatient services (18,400 SF)	818,800		
j.	Construct patient processing (20,940 SF)	869,000		
k.	Construct supply and services (13,780 SF)	447,800		
l.	Construct circulation and mechanical spaces (129,970 SF)	4,074,600		

Revised Summary of Costs for Step 4 (continued)

		February 1969 Costs	Escal. Index	Escalated Bid Costs
m.	Construct mechanical equipment rooms (14,400 SF)	$ 1,288,000		
n.	Install additional East Block mechanical equipment	750,000		
o.	Additional roof work	150,000		
p.	Equipment and casework	1,550,000		
q.	Vertical transportation	1,600,000		
r.	Material handling system	1,500,000		
s.	Temporary work	330,000		
t.	New sanitary and storm sewers, water and gas	150,000		
u.	Landscaping	125,000		
v.	New electrical equipment	280,000		
Total Step 4		$34,847,300	130.7	$45,545,400
Escalated project cost Step 4				55,985,600



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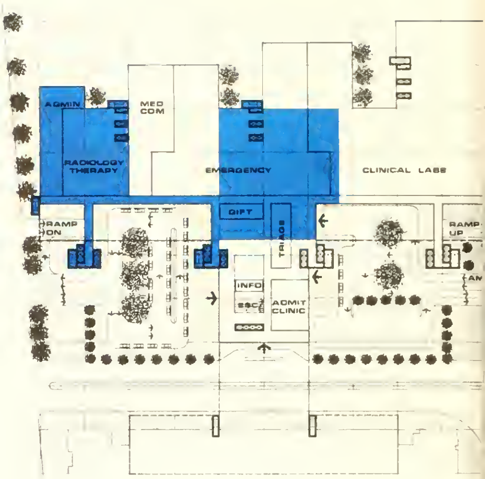

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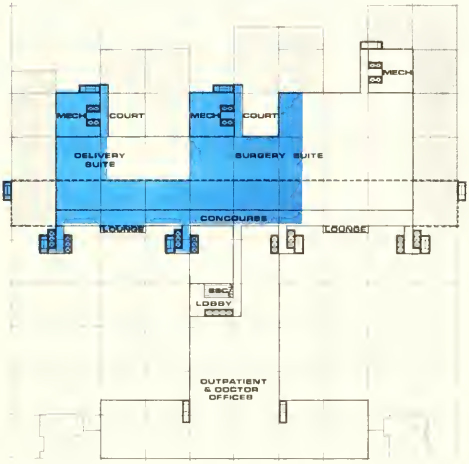

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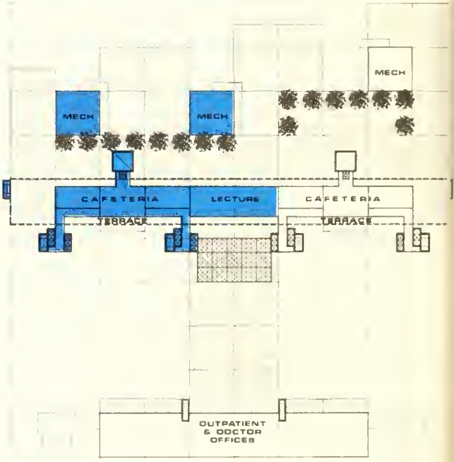
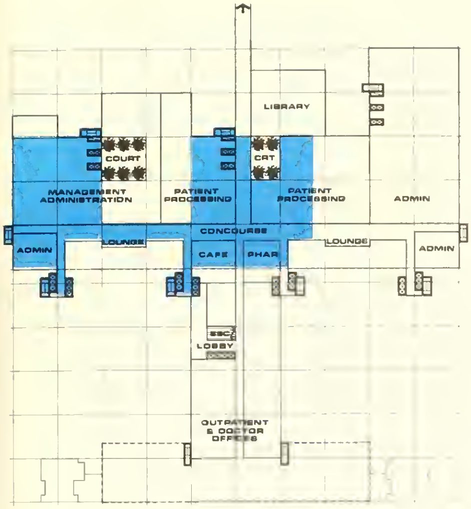


LEVEL 5

STEP 4



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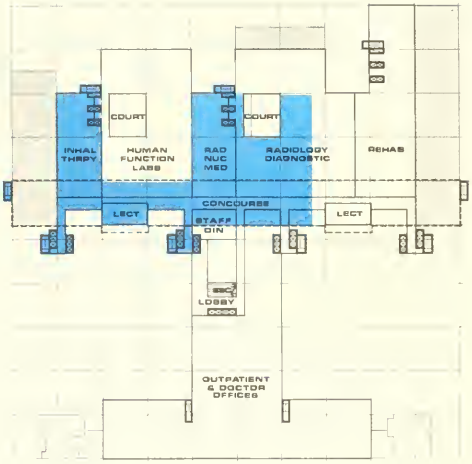

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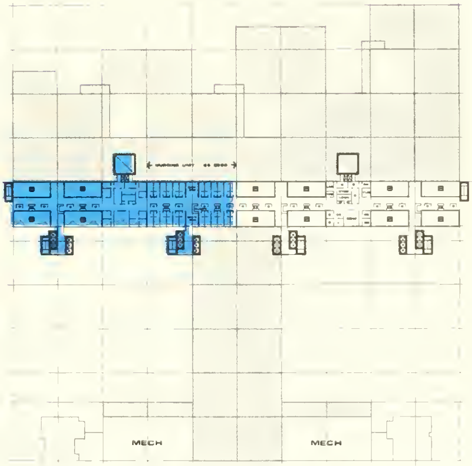


LEVELS 6-20

MAIN BLOCK

3.1.5 REVISED SUMMARY OF STEP 5

Design and construct the final half of the 15-story High-Rise and remaining portions of administrative services, core services, dietary, emergency services, patient processing, outpatient clinics, and underground parking.

With the relocation of kitchen, central sterile supply, laundry, and pharmacy to the Service Building (completion of steps 3 and 4 is coincident) and the relocation of inpatients from Dowling, Medical, and Curley Pediatrics Buildings, the existing buildings on the Main Block may be demolished, providing the necessary land area for the implementation of step 5.

Level B will contain additional underground parking for 300 cars, and the remaining portions of housekeeping and locker room facilities. Level 1 will contain the ambulance court, remaining portions of clinical laboratories and emergency. Level 2 will contain remaining portions of patient processing, and administration. Level 3 will contain human functions laboratories, remaining portions of diagnostic radiology, and rehabilitation. Level 4 will contain additional space for surgery suite and delivery suite. Level 5 will contain additional cafeteria and dining facilities, and additional lecture room. Level 6 will contain additional outpatient clinics. Levels 7 through 20, the High-Rise portions will contain inpatient services.

During step 5 all systems (material handling, vertical transportation, utility) started in previous steps will be expanded to serve the entire completed facility, and additional mechanical and refrigeration equipment will be installed.

Revised Summary of Procedure for Step 5

a. Design: start May 1971

b. Demolish cafeteria, pharmacy, kitchen, and stores (3 months): start April 1973

c. Relocate acute beds and core service functions to new Hospital facilities completed during step 4: October 1973

d. Demolish Medical Building, Curley Pediatrics Building, Dowling Building, and Administration Building (4 months): start October 1973

e. Construction (23 months): start July 1973

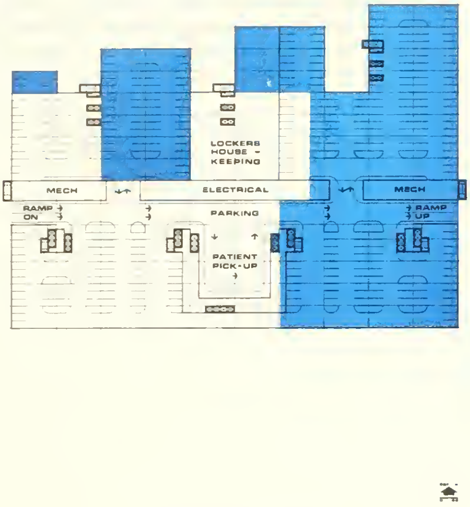
f. Occupancy: June 1975

Revised Summary of Costs for Step 5

		February 1969 Costs	Escal. Index	Escalated Bid Costs
a.	Demolish pharmacy, cafeteria, kitchen, stores, Medical Building, Curley Pediatrics Building, Dowling Building, Administration Building	$ 531,800		
b.	Piles and foundations	420,000		
c.	Underground parking (107,290 SF)	965,600		
d.	Construct administrative services (48,340 SF)	2,006,100		
e.	Construct core services (157,620 SF)	9,063,100		
f.	Construct dietary (7,320 SF)	333,000		
g.	Construct emergency services (17,570 SF)	979,400		
h.	Construct inpatient services (257,600 SF)	13,459,600		
i.	Construct outpatient services (18,400 SF)	818,800		
j.	Construct patient processing (17,170 SF)	712,500		
k.	Construct supply and services (5,520 SF)	179,400		
l.	Construct circulation and mechanical spaces (94,510 SF)	2,962,900		

Revised Summary of Costs for Step 5 (continued)

		February 1969 Costs	Escal. Index	Escalated Bid Costs
m.	Construct mechanical equipment rooms (7,200 SF)	$ 944,000		
n.	Install additional Mechanical equipment in East Block	750,000		
o.	Additional roof work	150,000		
p.	Equipment and casework	2,525,000		
q.	Vertical transportation	1,100,000		
r.	Material handling system	1,500,000		
s.	Temporary work	200,000		
t.	New sanitary and storm sewers, water and gas	250,000		
u.	Landscaping	125,000		
Total Step 5		$39,976,200	144.8	$57,885,500
Escalated project cost Step 5				71,238,200



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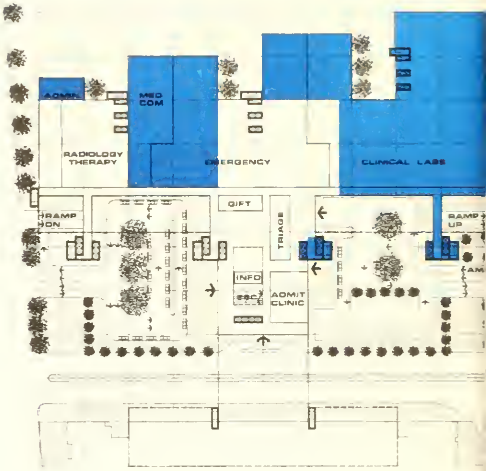

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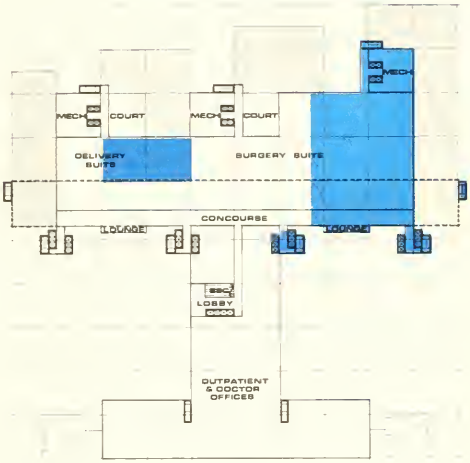

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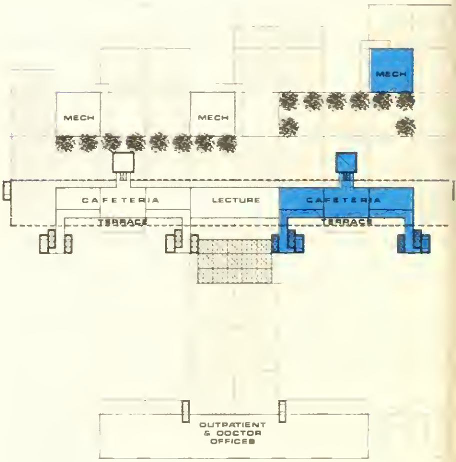

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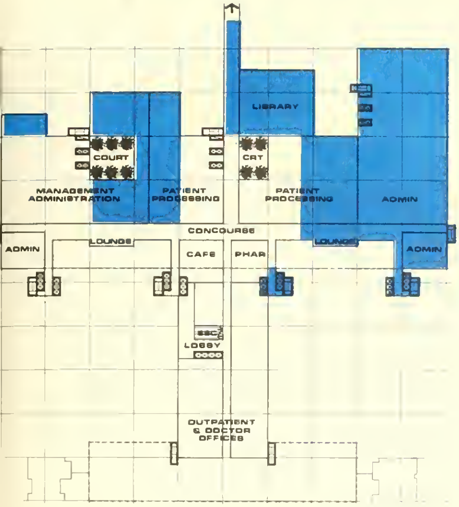
STEP 5



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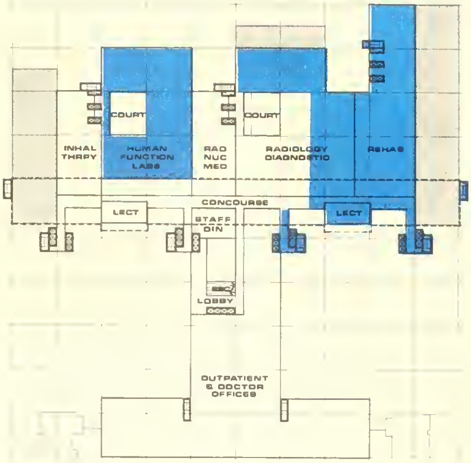

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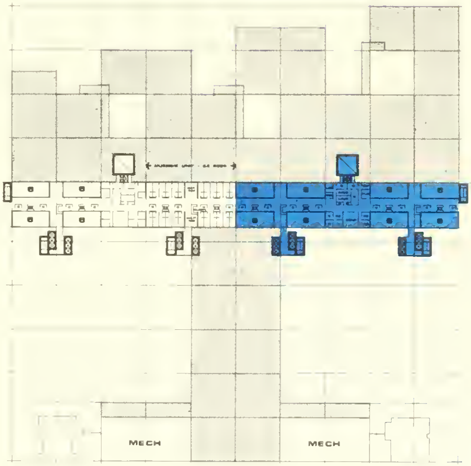

LEVELS 6-20

MAIN BLOCK

3.1.6 REVISED SUMMARY OF STEP 6

Design and construct parking structures for approximately 300 cars along East Concord Street. Demolish the buildings remaining on the Main Block, whose functions and occupants will have moved to the new facility. Complete the landscaping of the site.

The parking structures will be designed so that future and as yet unprogrammed research facilities can be built over the structures.

Revised Summary of Procedure for Step 6

a. Design: start January 1974

b. Relocate functions by June 1975

c. Demolish outpatient, Wards BCD, X-ray annex, surgical, cobalt unit, and maternity buildings (3 months): start June 1975

d. Construction (10 months): start September 1975

e. Occupancy: June 1976

Revised Summary of Costs for Step 6

		February 1969 Costs	Escal. Index	Escalated Bid Costs
a.	Demolish Outpatient Building, Wards BCD Building, X-ray Annex, Surgical Building, Cobalt Unit, Maternity Building	$ 310,600		
b.	Parking structures	1,059,800		
c.	Landscaping	300,000		
Total Step 6		$1,670,400	154.0	$2,572,400
Escalated project cost Step 6				2,932,500

DESCRIPTION	ELEMENT NSF LGA	ELEMENT NSF HS/RA	ELEMENT [4] GSF LGAI	ELEMENT [5] GSF
ENTITY TOTAL - ADMINISTRATIVE SERVICES	49,520	49,520	86,700	68,100
Administration	31,010	31,010	54,300	43,000
Management	18,510	18,510	32,400	25,100
ENTITY TOTAL - CORE SERVICES	176,600	179,100[1]	308,870	246,120
Central sterile supply	10,970	10,970	19,200	13,070
Clinical labs	33,480	33,480	58,700	46,160
Delivery suite	8,270	8,270	10,250	13,130
Human functions lab	14,225	14,225	24,900	21,450
Inhalation therapy	4,990	4,990	8,200	7,360
Lecture rooms	6,900	6,900	12,070	8,960
Medical communications	7,320	7,320	12,810	9,830
Medical library	3,690	6,190	10,830	9,230
Pharmacy	8,130	8,130	14,230	9,760
Radiology - diagnostic	18,490	18,490	32,350	23,910
Radiology - nuclear	5,590	5,590	9,780	7,360
Radiology - therapy	6,730	6,730	11,770	9.830
Rehabilitation	12,105	12,105	21,180	17,570
Surgery suite	35,710	35,710	62,600	48,500
ENTITY TOTAL - DOCTORS' OFFICES	48,240	48,240	84,410	67,780
ENTITY TOTAL - DIETARY	40,510	40,510	70,900	56,890
Administration	3,940	3,940	6,900	4,730
Food supply	5,680	5,680	9,940	6,820
Kitchen	12,300	12,300	21,560	24,870
Dining	18,590	18,590	32,500	20,470
ENTITY TOTAL - EMERGENCY	24,670	24,670	43,170	34,950
Entrance	3,070	3,070	5,370	4,700
Support facilities	2,490	2,490	4,350	3,500
Treatment facilities	12,550	12,550	21,960	17,570
Diagnostic/holding	5,030	5,030	8,800	7,030
Personnel area	960	960	1,700	1,350
Cardiac resuscitation	570	570	990	800
ENTITY TOTAL - INPATIENT SERVICES	307,280	390,450[2]	537,800	515,200[2]
Intensive care	19,620	19,620	34,300	27,600
Acute care	243,460	243,460	426,000	322,000
Extended care	27,720	27,720	48,500	36,800
Chronic care		83,170		110,400
Other inpatient services	16,480	16,480	29,000	18,400
ENTITY TOTAL - LAUNDRY	22,660	22,660	39,900	24,740
ENTITY TOTAL - OUTPATIENT SERVICES	83,120	83,120	145,500	114,460
Administration	2,330	2,330	4,170	3,260
Health education	1,140	1,140	1,990	1,590
Child day care center	6,670	6,670	11,670	9,300
Employee health services	2,820	2,820	4,930	3,900
State vd program	780	780	1,500	1,050
Nurses services	3,200	3,200	5,600	4,100
Clinics A through W	66,080	66,080	115,640	91,260
ENTITY TOTAL - PATIENT PROCESSING	27,060	27,060	47,350	41,790
Triage	1,990	1,990	3,480	3,140
Admitting clinic	6,990	6,990	12,220	7,970
Discharge	3,550	3,550	6,250	4,970
Medical records	14,530	14,530	25,400	25,710
ENTITY TOTAL - PHYSICAL PLANT	24,040	24,040	42,100	28,840
Maintenance of buildings & grounds	17,980	17,980	31,500	20,840
Safety	1,260	1,260	2,200	2,000
Automotive maintenance	4,800	4,800	8,400	6,000
ENTITY TOTAL - SUPPLY & STORAGE	56,870	56,870	99,500	81,920
Housekeeping	8,970	8,970	15,700	12,000
Locker rooms	6,080	6,080	10,600	7,300
Storage	41,820	41,820	73,200	62,620
SUBTOTAL	860,570	940,640	1,506,200	1,280,790
Mechanical plant			18,750	29,400
SUBTOTAL	860,570	940,640	1,524,950	1,310,190
Circulation & mechanical				324,300[3]
SUBTOTAL			1,524,950	1,634,490
Parking				570,000
TOTAL				2,204,490

[1] Increase from LGAI program
[2] Increase due to 300 chronic care beds
[3] Included in LGAI gross figures
[4] Based on an average net to gross ratio of 1.75 for the entire hospital
[5] Based on an average net to gross ratio of 1.40 for the major entities

PROGRAM AREA COMPARISON

APPENDIX B

AGENDA FOR DESIGN REVIEW OF ADDENDUM TO BCH MASTER PLAN, SEPTEMBER 8, 1969.

1. Review of alternate concept plans
2. Review of cost comparisons
3. Review of construction and phasing schedules

NOTE: In addition to exploring alternate concepts of relocating the Outpatient Building two other new factors indicated by the PFD have been considered in the studies:

1. The PFD will permit separate contracts to be let for foundations, steel frame, and major building construction.
2. Interim relocation of facilities should not be planned for the East Block. If possible existing buildings on site should be used.

EVALUATION OF BCH ADDENDUM CONCEPTS

Each concept presented will be evaluated on the following basis:

1. Functional relationships and program compliance, i.e. relationship of Outpatient Building to core services, triage, and emergency.
2. Construction scheduling
3. Construction costs
4. Internal circulation and vehicular access
5. Distance from center line of High-Rise to center of Outpatient Building.
6. Construction problems - structural and mechanical
7. Expansion potential

The concepts are identified as follows:

CONCEPT A

Outpatient Building totally contained on South Block, nurses housing and school partially redesigned.

CONCEPT B

Outpatient Building totally contained on South Block, nurses housing and school relocated to Main Block.

CONCEPT C

Outpatient Building built over Massachusetts Avenue on air rights.

CONCEPT D

Master plan as submitted, June 1969.

Each concept differs from the master plan in that:

1. The mock-up nursing unit could not easily be constructed and operated.
2. Approval must be obtained at an early date concerning the construction of facilities over Massachusetts Avenue.

EVALUATION OF BCH ADDENDUM CONCEPT A.

1. The LGAI program and the master plan call for a very positive relationship between triage, outpatients, emergency, and core services. The only way to achieve this relationship in this concept study is to provide an elongated triage spanning Massachusetts Avenue from the South Block's Outpatient Building to the Core Services Building.

   As the distance from emergency and core services to outpatient clinics increases, the relationship becomes poorer. Due to the increase in this distance some diagnostic services, such as laboratory and diagnostic x-ray may have to be duplicated in the Outpatient Building, thus increasing building size, cost and staffing.

   The height of the building (7 stories above the plaza) makes the relationship to the future Hospital even more remote. In all the other studies each floor of the Outpatient Building is connected to the Core Service Building. This would be impossible to accomplish with this concept.

2. Substantial redesign of the South Block project would be required. This could delay the project by as much as one year. Even if foundations were bid early the combined design time of the Outpatient Building and the redesign time of the South Block would substantially be more than all other concepts except Concept B.

3. Construction cost: Approximately $600,000 less than total escalated bid cost of the master plan, June 1969, (see cost analysis in Appendix.)

   Step 4 of the Hospital could be started prior to the completion of Step 1 since the High-Rise portion is south of the existing buildings and does not depend on relocation functions in existing buildings.

4. Internal circulation and vehicular access: Due to the height of the building and its distance

from the elevators of the High-Rise, the vertical transportation systems would be expanded over what was shown in the master plan for the four-story Outpatient Building.

Vehicular access would be by means of ramps to the triage over Massachusetts Avenue. Due to the length required to provide a maximum slope of 12% the auto entrance is not easily seen from Massachusetts Avenue. Whereas any auto entry might be achieved without ramps, it would be impossible to maintain the horizontal relationships between emergency, triage and outpatient departments.

Since the Outpatient Building will be completed before the nursing school by 6 - 9 months, auto access for that period would be through the construction zone. Unless partial occupancy is obtained from the nursing school contractor, there would be no parking on the site until completion. Pedestrian arrivals would be disadvantaged or a separate triage provided at the ground floor.

5. Distance from center line of High-Rise to center of Outpatient Building 300 feet.

6. Mechanical: If a separate independant mechanical plant is built in Step 1, approximately 1,200 tons of cooling would be required. If, on the other hand, cooling would be provided by the central power plant (Step 2) only 900 tons of cooling would be required due to the larger capacity machines, handling not only the Outpatient Building, but other future hospital buildings. Annual operating costs of the separate system would be 20% greater than for the central system.

7. The expansion potential of a self contained Outpatient Building on the South Block is limited because by containing all outpatient and doctors' offices in one structure the only possible expansion is vertical.

   Expanding a building 7 stories high causes the following problems:

a. The structure and foundations must be designed initially for the extra floors, thus forcing the BCH and PFD and the architect to make an assumption of the future total height in the master plan or schematic phase.

b. Vertical transportation systems must be expanded at a future date or new systems added. This is costly.

c. If mechanical equipment is placed on the roof of the initial construction it would have to be relocated when expansion occurs. In addition the equipment would either have to be sized to accommodate future expansion or additional equipment installed in the future.

d. Vertical expansion seriously disadvantages the operation of the hospital and the occupants of all the floors below.

EVALUATION OF BCH ADDENDUM CONCEPT B.

1. The relationship between outpatients and triage, emergency and core services is similar to the master plan, although elevated one floor. Due to the width of Massachusetts Avenue similar distance are increased 45 feet. Other departments would change floors. However, program compliance could be achieved as in the master plan.

2. This concept would delay the start of construction the most since current plans for the South Block would have to be scrapped and the Outpatient Building's parking and entry redesigned.

3. Construction costs: The cost of Step 1 increases to approximately $8.2 million, although the total escalated bid cost remains the same as in the master plan. See attached cost analysis.

4. Internal circulation is similar to that of the master plan.

   Vehicular access is more involved and costly due to ramps for entry to triage and emergency.

5. The distance from the center line of the High-Rise to the center of the Outpatient Building is 215 feet.

6. Construction problems: Construction problems would be similar to those indicated in the master plan. However, mechanical runs would be slightly longer.

7. Expansion could be accomplished in a similar manner as indicated in the master plan. The expansion of the outpatient clinics would be on the South Block.

EVALUATION OF BCH ADDENDUM CONCEPT C.

1. The functional relationships between outpatients, triage, and emergency remain same as in the master plan.

2. The Outpatient Building to be built immediately on the parking area between Vose House and Dowling and over Massachusetts Avenue. Redesign of the South Block is minimal. Both projects may proceed simultaneously. Therefore the concept could start and be completed earlier than any other concept.

3. Construction costs: Escalated bid cost is approximately 1.5 million less than the master plan.

4. Internal circulation and vehicular access is similar to the master plan.

5. The distance from the center line of the High-Rise to the center of the Outpatient Building is 195 feet.

6. Minor structural problems in building over Massachusetts Avenue; otherwise similar to master plan. The southern row of support columns will, however, occur between the northern building line of the nurses college and the property line along Massachusetts Avenue.

7. Expansion of Outpatient Department is possible in the areas presently occupied by Dowling Building; otherwise similar to master plan.

EVALUATION OF THE MASTER PLAN, CONCEPT D.

As a means of comparing Concepts A, B, and C with the master plan, the following items should be noted:

1. The relationship between outpatients and triage, emergency and core services is shown in detail in the master plan. It should be pointed out that the Outpatient Building is accessible from core services at all four High-Rise elevator shafts.

2. Construction cannot commence without the demolition of Vose House and the second half of the Outpatient Building cannot be built until Dowling has been demolished prior to Step 5. However, except for Concept C this is still the quickest procedure for construction of the hospital.

3. Construction costs: see master plan.

4. Internal circulation and vehicular access would be the same as in Concept C, and better than Concepts A and B.

5. Distance from the center line of the High-Rise to the center of the Outpatient Building is 170 feet.

6. As described in the master plan, construction starts with the demolition of Vose House.

7. As described in the master plan.

SUMMARY OF CONSTRUCTION COSTS FOR CONCEPTS A, B, C, AND D.

By increasing the areas built in Step 1 of doctors' offices, outpatient services, patient processing, mechanical equipment, mechanical and circulation spaces, there has been a saving in escalation costs in Concepts A, B, and C of approximately $600,000, since most of the area increased in Step 1 was scheduled for construction in Step 5.

Additional savings would be realized since the mock-up nursing unit and interim space in the Service Building would not be built.

Assuming construction phasing as shown in the master plan, and providing for the area adjustments to the doctors' offices and outpatient service entities Step 4 would decrease by $844,000 and Step 5 by $2,753,500.

The following is a tabulation of revised construction costs for Concepts A, B, and C:

Step	February 1969 Costs	Escal. Index	Escalated Bid Costs
Concept A			
1	$ 10,830,700	121.7	13,181,000
2	5,140,800	129.3	6,647,100
3	10,468,200	132.1	13,828,500
4	35,789,600	127.5	45,631,700
5	41,227,500	144.8	59,697,400
6	1,670,400	154.0	2,572,400
Total	$ 105,127,200		141,558,100
Concept B			
1	13,350,700	121.7	16,247,800
2	5,140,800	129.3	6,647,100
3	10,468,200	132.1	13,828,500
4	35,789,600	127.5	45,631,700
5	41,227,500	144.8	59,697,400
6 Absorbed by Step 1	---	154.0	---
	$ 105,976,800		142,052,500
Concept C			
1	10,006,600	121.7	12,178,000
2	5,140,800	129.3	6,647,100
3	10,468,200	132.1	13,828,500
4	35,789,600	127.5	45,631,700
5	41,227,500	144.8	59,697,400
6	1,670,400	154.0	2,572,400
	$ 104,303,100		140,555,100

COST AND SCHEDULE IMPLICATIONS OF DELETING INTERIM SPACE FROM SERVICE BUILDING.

Revised cost estimate is based on the following new parameters established by the PFD in discussions since the completion of the master plan in June, 1969.

1. The building of interim space in the East Block's Service Building in Step 2 should be avoided. Relocation of functions in Peabody Burnham and Wards FGH could be accomplished in other existing buildings on the site, vacated after Step i is completed.
2. Separate foundation and structural steel frame contracts would be let prior to the major building contract.

Revised Estimate for Service Building - East Block; Deletion of Interim Space from Master Plan Estimate.

Step 2

a.	Demolish City Machine Shop	76,800
b.	Construct new mechanical plant (29,440 SF)	2,528,700
c.	Construct piles, foundations and parking (171,910 SF)	1,900,300
d.	Circulation (4,500 SF)	90,000
e.	Vertical transportation	120,000
f.	Connect utility lines	410,000
g.	Temporary work	15,000
	Total Step 2	$5,140,800
	Escalated bid costs (129.3)	$6,647,100

Step 3

a.	Demolish power plant, smoke stacks, maintenance shops	280,600
b.	Construct piles, foundations and parking (119,600 SF)	1,694,000
c.	Construct core services (20,550 SF)	868,700
d.	Construct dietary (36,740 SF)	1,856,800
e.	Construct laundry (24,740 SF)	1,450,400
f.	Construct physical plant (28,840 SF)	828,700
g.	Construct supply & services (62,620 SF)	1,991,200
h.	Construct circulation (20,920 SF)	655,800
i.	Vertical transportation	300,000
j.	New sanitary and storm sewers, water and gas	30,000
k.	Site work	12,000
l.	Albany Street bridge	200,000
m.	Permanent utility connections	300,000
Total Step 3		$10,468,200
Escalated bid costs (132.1)		13,828,500

Master Plan Estimate

	February 1969 Costs	Escalated Bid Costs
Step 2	$ 6,765,300	$ 8,747,500
Step 3	9,415,500	12,434,000
	$16,180,800	$21,181,500

Without Interim Space

Step 2	$ 5,140,800	$ 8,747,500
Step 3	10,468,200	13,828,500
	$15,609,000	$20,475,600
Difference	- 571,800	- 705,900

A portion of this saving would be spent on the remodeling of the existing Outpatient Building and/or Medical Pavilion III to accommodate the functions in Peabody Burnham Building and Wards FGH. It is impossible to estimate the remodeling cost without a detailed study.

The deletion of the interim space from the Master Plan would delay the construction of Steps 3, 4, 5, and 6 by one year.

CONCEPTS A, B, & C.

The movement of the High-Rise southward in each of these concepts allows the retention of Peabody Burnham and Wards FGH to a later date and eliminates the need for interim space on the East Block. Therefore, the cost savings ($705,900) would apply equally to each scheme.

INCORPORATION OF THE OUTPATIENT BUILDING INTO THE HOUSING COMPLEX PROPOSED FOR THE SOUTH BLOCK

Incorporation of the functions currently planned for the Outpatient Building into the housing complex of the South Block would have the following disadvantages:

1. The physical size of the Outpatient Building would be in excess of 200,000 square feet. If this were to be incorporated into the structure currently designed for the South Block it would require major revisions to that project. The resulting complex would produce an Outpatient Building with very poor physical relationship to the Hospital.

2. The relationship between the School of Nursing and the outpatient clinics is not strong enough to warrant relocation of the clinics to the South Block.

3. The LGAI program recommends a strong relationship between inpatient, outpatient emergency services, and the triage/admitting clinic. There would be no central control possible if these functions are physically separated on two separate blocks.

4. Due to the poor relationship between the Outpatient Building and Core Services many services would have to be duplicated (e.g. diagnostic X-ray, inhalation therapy, radiology, nuclear medicine,) otherwise the services provided the outpatient will prove very time-consuming and inconvenient.

5. The inevitable post-1975 expansion of the Outpatient Building would be very difficult. It could only be accomplished by crowding out other functions of the complex such as housing or parking and would be very expensive, as expansion and flexibility were not part of the design criteria for the South Block.

6. The flat slab construction of the current South Block design cannot accommodate an outpatient department. The 8'-8" floor to floor heights will not permit the horizontal runs of mechanical services needed. It would require major revisions to accommodate the mechanical services with a corresponding delay in the total project.

7. The materials handling system will deliver and originate 1100 Cyberail container of supplies per day. It is doubtful if this amount of material traffic could be accommodated into the existing South Block complex without a systems floor.

8. Separation of the Outpatient Building from the remainder of the Hospital would no longer permit the sharing of elevator systems and will require a separate system to serve the Outpatient Building.

9. The Outpatient Building would require 1200 tons additional airconditioning. Location of this equipment on the East Block would be costly due to its distance from the South Block. Conversely, if the air conditioning system is separately designed and located on the South Block, there would be serious economic disadvantages in initial cost and annual operational costs. Redesign of the entire South Block's airconditioning system to provide the additional 1200 tons of air-conditioning is not seen as a viable alternative.

10. Due to the lengthy construction period of the South Block's housing complex, the outpatient services and doctors' offices located in the podium could not be completed until the remainder of the construction, which would probably delay its completion past the date of other alternatives.

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